MODERN PLASTICS

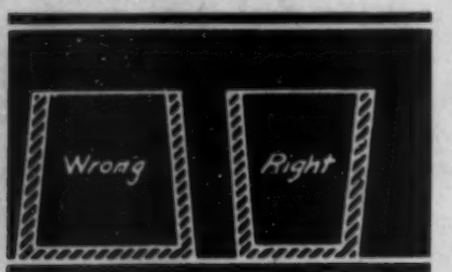
JANUARY 1944

DESIGN DATA ON PLASTICS

FROM THE DUREZ LABORATORIES

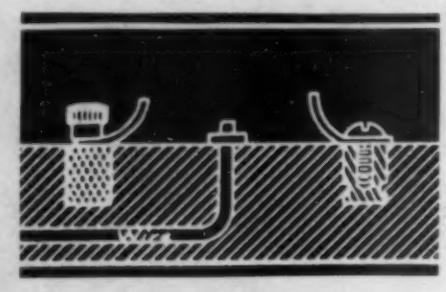
The engineer who is designing plastic parts usually finds himself facing five major considerations: (1) ease of production, (2) purpose of the part, (3) service conditions, (4) cost, (5) selection of materials.

Within these broad categories there is a wealth of opportunity for good design technique, and almost as many pitfalls. Our own experience never fails to emphasize one all-important fact. *A satisfactory plastic part is most often obtained when there is close cooperation between product engineer, molder and the producer of the plastic material.*



UNDERCUTS: They run up costs . . .

Durez compounds provide you with unusual latitude when it comes to moldability or ease of production. But a study of twenty years of data files on literally thousands of designing problems indicates there may be many factors involved. Of these factors, the following are especially important:



INSERTS: Imbedding in Durez makes important savings . . .

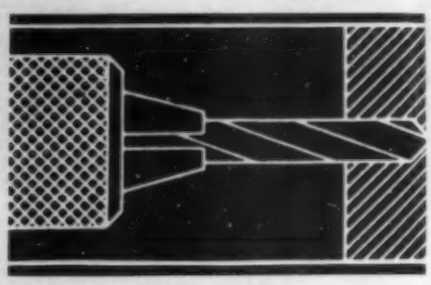
Undercuts should be avoided wherever possible because Durez sets up hard in the mold. Split molds can handle undercuts, of course, but it runs up cost.

On the other hand, when it comes to inserts, Durez will help you to keep cost down because contacts, terminals, wires and inlays can be imbedded during the molding process. This makes later assemblies easier, less expensive and stronger.

Provided they can be withdrawn from mold, decorative details can be included in any Durez piece. Simple lettering and trademarks involve no problem.

Strong, precise threads are easily molded, permitting permanent joining of sections, or easy removal without binding.

With Durez materials, it is practical to include machining. However, good designing can eliminate much machining which is always costly and should be avoided. Of course, a machining operation will sometimes eliminate a split or complicated, costly mold.



MACHINING: Good designing can often avoid costly machining . . .

Here we are only scratching the surface on the moldability of Durez compounds. Our files probably include much interesting data on cases which are similar to your own problem. If you have a plastic part or product in mind, we should like to hear from you. We offer our laboratory facilities and the experience of qualified technicians in helping you find your answer. Durez Plastics & Chemicals, Inc., 51 Walck Road, N. Tonawanda, New York.

DUREZ

PHENOLIC MOLDING COMPOUNDS AND RESINS

PLASTICS THAT FIT THE JOB

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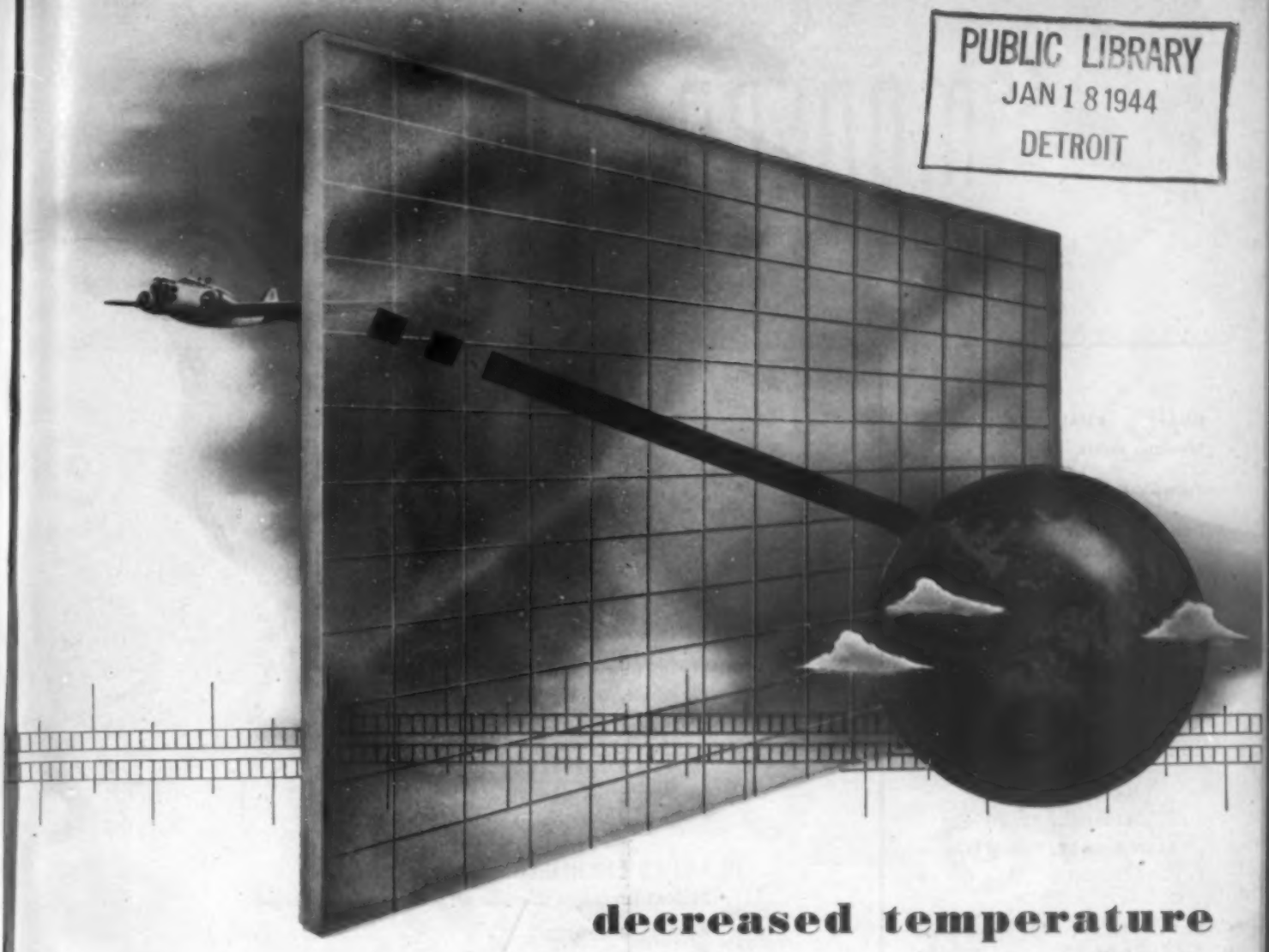

decreased temperature ... increased strength

The use value of some plastic materials decreases as the temperature decreases . . . They either weaken or become brittle. Loalin, on the other hand, becomes increasingly stronger as the surrounding temperature drops. Because of this unusual, but highly desirable characteristic, Loalin has been singled out as a material ideally suited to the needs of the aviation and refrigeration industries.

At 40°C. Loalin Polystyrene molding compound has a tensile strength of 6,000 lbs. per sq. in. At −35°C. its tensile strength is 8,300 lbs. per sq. in. A marked strength-factor increase.

Added to this are many other basic reasons for Loalin's rapidly expanding usefulness. It is noted for its high dimensional stability and consequent freedom from warpage. As an insulating material Loalin is twice as efficient as the material which most closely approximates it (Catalin Cast Phenolics). It compares favorably with such specialty insulators as felt, cork board and expanded rubber, a property that is particularly important when the use of plastics is included in the sealing frames and in the evaporator doors of electric refrigerators.

In normal service many refrigeration parts are in constant contact with tomato and citrus juices, vinegar, alcohol and cleanser materials containing high concentrations of free alkalies. Parts molded of Loalin are not affected, even through long contact. By being odorless and tasteless, Loalin also possesses properties held in high regard by refrigeration interests.

Another factor not to be overlooked by sales-minded manufacturers is the element of Loalin's style and beauty. It can be formulated in an unlimited range of transparent, translucent or opaque colors.

Whenever you are ready to don your postwar thinking cap, the members of our engineering and planning staff will be glad to furnish you with helpful suggestions and complete details.

Cast Resins
Molding Compounds
Liquid Resins

CATALIN
CORPORATION

ONE PARK AVENUE • NEW YORK 16, N. Y.

ONE · OF · A · SERIES ON · THE · PHYSICAL · PROPERTIES · OF · PLASTIC · MATERIALS

MODERN PLASTICS

INCLUDING *Plastics Engineering*

Volume 21 JANUARY 1944 Number 5

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GENERAL INTEREST

Allocation of plastics 81
"Sighted sub, sank same" 83
Glider control tabs 87
Rapid, continuous injection of thermosetting materials 90
Orange juice extractor 92
Lacquer-type fabric coatings 93
New trends in railroad lighting 96
The future of plastics in aviation 100
Sabotaging the saboteur 106
Remote reading compass for aircraft 108

PLASTICS ENGINEERING

Molded-laminated phenolic propeller parts for aircraft 109
A fire-fighting horn 116

TECHNICAL SECTION

Advance in plastics during 1943 123
Effects of thermo-elastic forming on properties of thermosetting laminates 127
Production of synthetic resins in 1942 132
Technical briefs 134
Plastics digest 136
U. S. plastics patents 138

NEWS AND FEATURES

Product development 98
Plastics in review 104
Machinery and equipment 152
Publications 154
Washington round-up 156
In the news 160
Conservation exhibit in Washington 166
London letter 168

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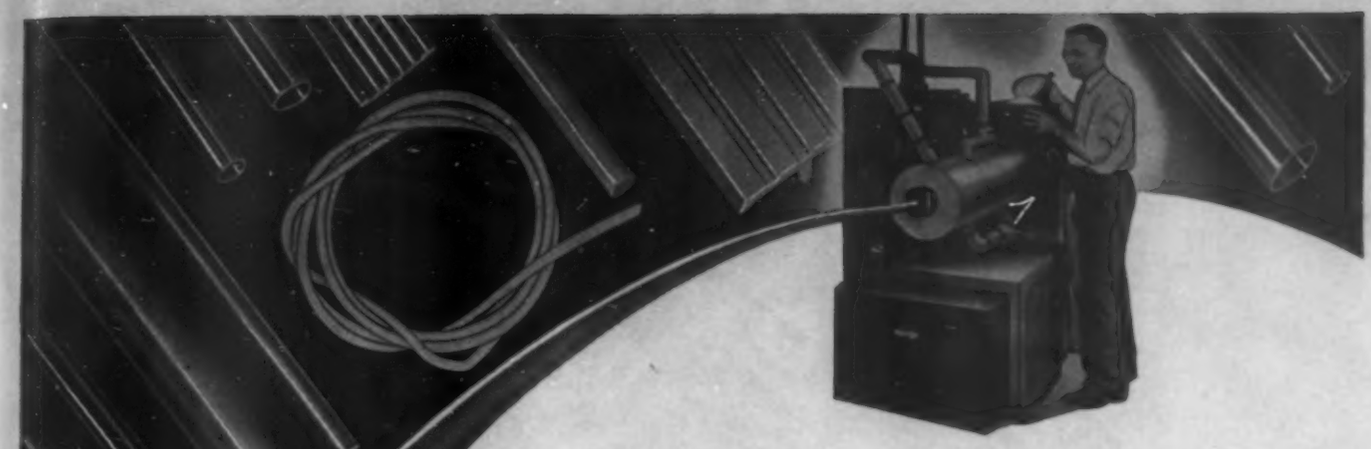
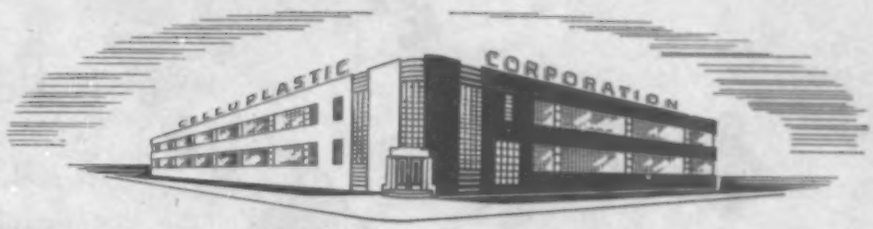


This is what Celluplastic Corporation does with National extruders

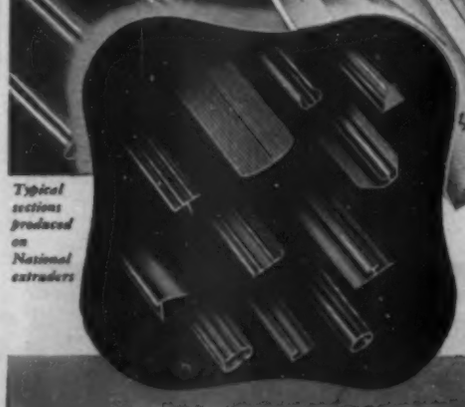


ROD, tubing, trim, flat-sections, molding . . . these are just a few of the many types of extrusions being produced at the Newark, N. J., plant of Celluplastic Corporation, New York.

But of all the various shapes coming from Celluplastic's big battery of National extruders, the company's current pride is its thin-wall tubing, a practical example of which is the body of the tooth-paste tube illustrated at the left.

Here is a job that calls for exceedingly close control over tolerances, uniformity and roundness, all of them problems that are greatly intensified by the hairbreadth thinness of the tubing wall.

It's a job which the Celluplastic organization is doing skillfully, smoothly and effectively. It's the type of job that National extruders, backed by sound engineering and a complete Pilot Plant to prove performance by production, can help others to do, too.



Typical sections produced on National extruders

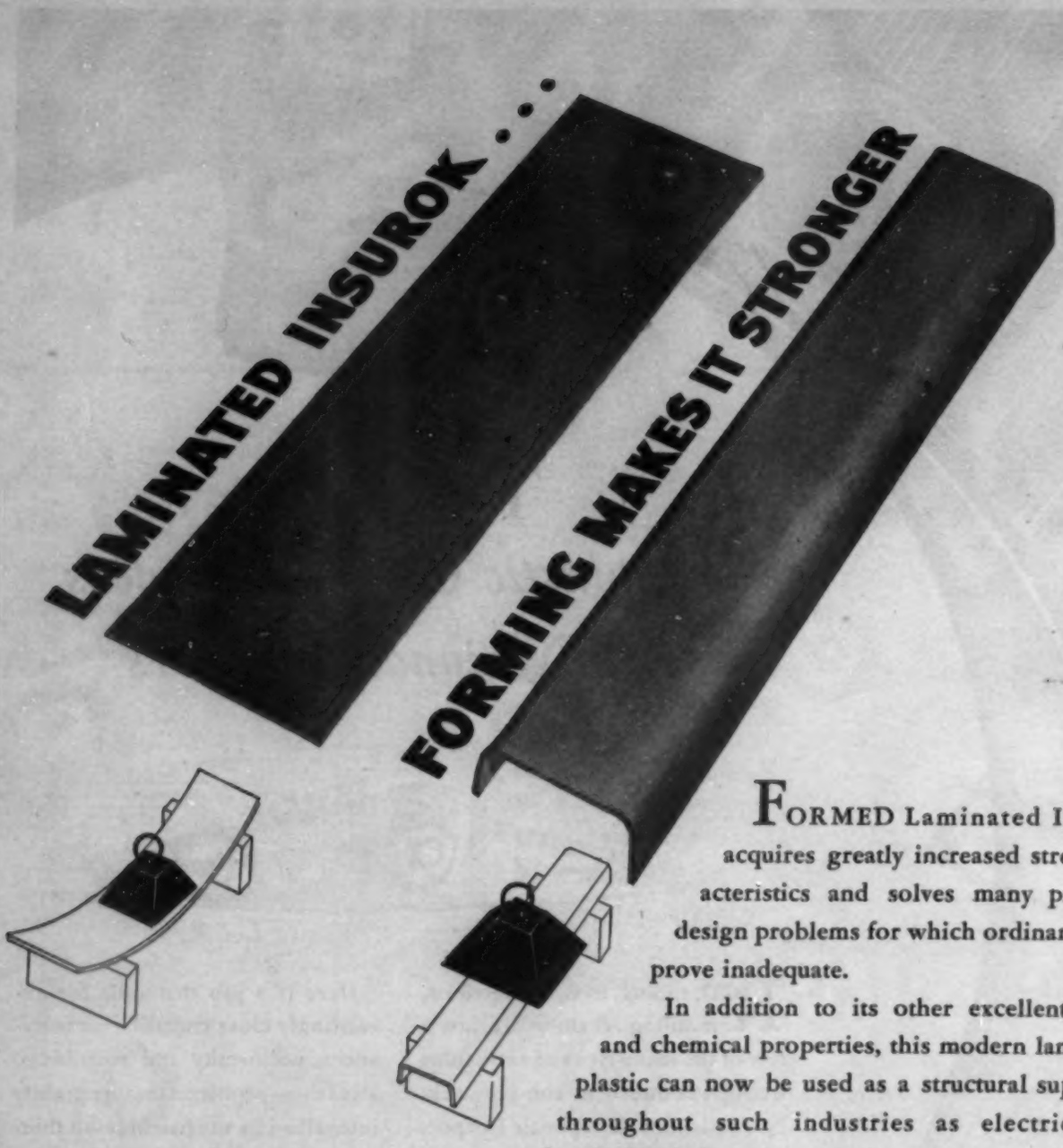
ARMY E NAVY

CLIPTON DIVISION

Plastics Division

NATIONAL RUBBER MACHINERY COMPANY

GENERAL OFFICES: AKRON, OHIO



FORMED Laminated INSUROK acquires greatly increased strength characteristics and solves many product and design problems for which ordinary laminates prove inadequate.

In addition to its other excellent physical and chemical properties, this modern laminated plastic can now be used as a structural support throughout such industries as electrical, chemical, aviation, etc.

If you've held back in adapting a plastic for your product because of insufficient strength characteristics, you may be able to change over now to advantage. Why not call a Richardson Engineer and find out what Formed Laminated INSUROK can do for you?

INSUROK

Precision Plastics

The RICHARDSON COMPANY

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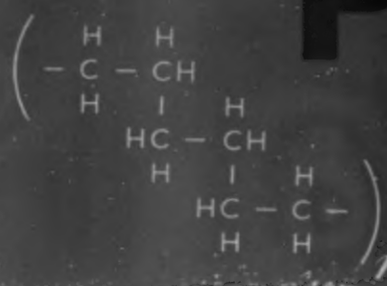
ANNOUNCING A NEW PLASTIC BY DU PONT

POLYTHENE



—CURRENTLY FOR WAR PURPOSES

Light in weight, extremely low in water absorption and moisture permeability, exceptional electrical properties

Now—after five years of intensive experimentation and development work—Du Pont announces polythene.* This is a new and unique plastic suitable for a wide variety of applications. Developed by Du Pont under basic U.S. product and process patents (U.S.P. 2153553 and 2188465)—exclusive rights to which are owned by Du Pont—polythene is in production to meet certain war needs.

Several distinct advantages indicate the use of polythene for many applications long considered the proper sphere of plastics but impossible with materials available up to now. Note these special properties:

LOW WATER ABSORPTION—not more than 0.075% (A.S.T.M. method D 570-42). Water vapor transmission —0.4 grams per square meter per 24 hours at 25°C, 0.004" thickness (A.S.T.M. method D697-42T).

HIGH DIELECTRIC STRENGTH—1000 v/mil at 0.01" thickness, dielectric constant 2.2—2.3, with a power factor of less than .0005 over a wide range of frequencies.

VERY LOW SPECIFIC GRAVITY—0.92—0.93.

UNUSUAL LOW-TEMPERATURE FLEXIBILITY.

REMARKABLE CHEMICAL INERTNESS—resistant to water, alkalies, acids, and oxygenated solvents.

READY MOLDING AND FABRICATION BY PRESENT METHODS—with existing thermoplastic molding and shaping equipment. Polythene powder can be extruded, injection molded, compression molded and calendered. In sheet, rod or tube form it can be machined, cut, blown, blanked or swaged.

ADDITIONAL FACTS ABOUT DU PONT POLYTHENE—In stiffness, polythene lies between the so-called rigid and non-rigid types of plastics. Its tensile strength is 1500 psi. It is slow burning. It is soluble in hot aliphatic, aromatic, or chlorinated hydrocarbon solvents.

WIRE AND CABLE COVERING—the remarkable electrical properties and ease of extrusion of Du Pont polythene indicate wide usage in this field.

NOW AVAILABLE—polythene is available now in production quantities only by specific authorization through WPB order M-348. However, small lots for experimental purposes may be secured on proper application. Write for polythene properties chart and other data which will suggest to you ways in which you might take best advantage of the unusual qualities of this new plastic for war work. Address inquiries to E. I. du Pont de Nemours & Co. (Inc.), Plastics Department, Arlington, New Jersey.

**A generic name for a solid, tough polymer from ethylene*

DU PONT PLASTICS

An ever-growing family whose newest member is polythene

DU PONT

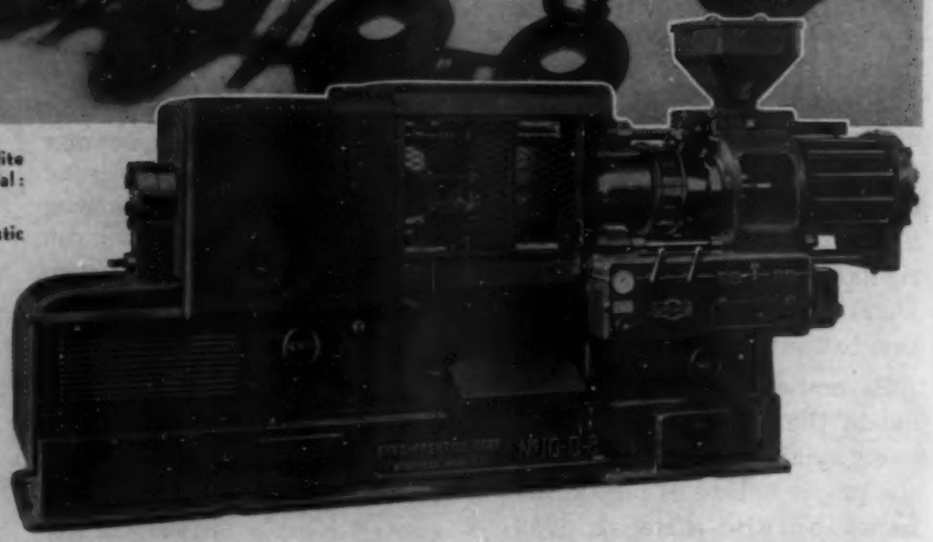
REG. U.S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

PRECISION VERSATILITY SERVICE

Hose connection ends molded by Udylite Corporation, Detroit, Michigan. Material: Tenite II, Cycle, 180 shots per hour.

Swirl mixer molded by Columbus Plastic Products, Columbus, Ohio. Material: Tenite I.



The swirl beverage mixer and the hose connections shown above save metal. They also exemplify the versatility and the precision of Reed-Prentice Plastic Injection Molding Machines. These pieces are molded on a Reed-Prentice 10D — 6 oz. machine.

In addition to a complete line of Injection Molding Machines of 4, 6, 8, 16 and 22 oz. capacities, Reed-Prentice also offers an engineering service available for consultation concerning machines to fit your individual needs, as well as a complete service for mold design and construction to meet your particular production requirements. Full information relative to this service will be supplied upon request.

BRANCH OFFICES
1213 W. 3rd. St.
Cleveland, Ohio
75 West St.
New York City, N. Y.

REED-PRENTICE CORP.

MAIN OFFICE
WORCESTER
MASS U.S.A.

Transparency, too, is put to work in these electrician's pliers — made for line testing, fuse pulling and the safe-handling of innumerable live-wire jobs.

The art of the molder and the versatility of Lumarith* (cellulose acetate base) plastics combine to create an improved product — lightweight, very tough and very practical. The husky utility man can bear down heavily; these pliers can take the pressure of his grip without breaking because Lumarith has unusual flexural strength.

If the subject has not come up recently in your plant, you may be surprised to learn that the great toughness and impact strength of Lumarith is replacing old line plastics whose brittleness has been a drawback. Great advances have been made in molding techniques effecting accuracy and impact strength. As in the case of the Signal Corps flashlight and the Army gas mask, parts can be made interchangeable with one another or with metal units.

If you have a conversion problem, we can help you very directly by putting you in touch with available molders and by advising on formulation and molding procedure. Celanese Celluloid Corporation, The First Name in Plastics, *a division of Celanese Corporation of America, 180 Madison Avenue, New York City 16. Representatives: Dayton, Philadelphia, Cleveland, Chicago, St. Louis, Detroit, Los Angeles, Washington, D. C., Leominster, Montreal, Toronto, Ottawa.*

Lumarith®
A CELANESE® PLASTIC

*Reg. U. S. Pat. Off.

IT'S TOUGH!

When you build up

over the years

a great reputation

as a foremost maker of quality

tooth brushes . . .

Pro-phy-lac-tic Tooth Brushes . . .

it's tough

to make some people

understand

that you are also

the country's

largest producer

of injection-molded

heavy section pieces!

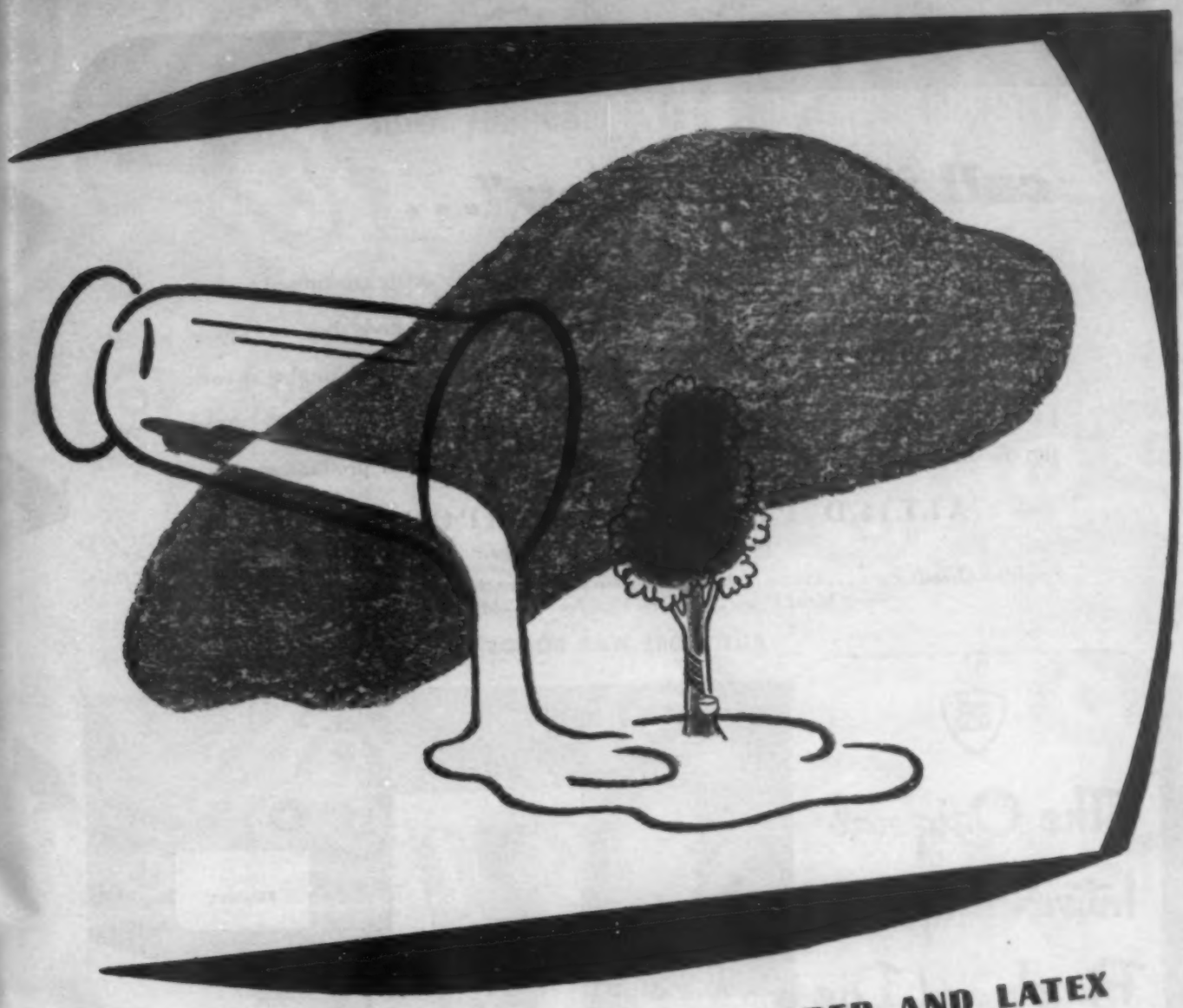
HAVE YOU A PLASTICS PROBLEM

Our Address is

PROLON PLASTICS

A DIVISION OF

Pro-phy-lac-tic Brush Co., FLORENCE, MASS.



DOES THE SHORTAGE OF CRUDE RUBBER AND LATEX PRESENT A MANUFACTURING PROBLEM TO YOU?

If you are faced with reduced production or a shut-down due to the limitations of rubber and latex, it is likely that we have, or can develop for you, a water-dispersed elastomer or composition that will meet your specific need for an economical rubber-like material. Let us know what your requirements are.

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under management UNITED STATES RUBBER COMPANY

symbolizing research and development in water dispersions

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call it "Know How"...

There are many names for skill and experience but no substitute for the combination. Through 15 years of peacetime production, Allied Products Corporation perfected the skill of its craftsmen and the facilities of its four great plants.

Now our many skills are turned to producing the tools and dies and parts needed for war. We are proud that each of our four plants flies the Army-Navy "E" for excellence of production.

ALLIED PRODUCTS CORPORATION

Detroit and Hillsdale, Michigan

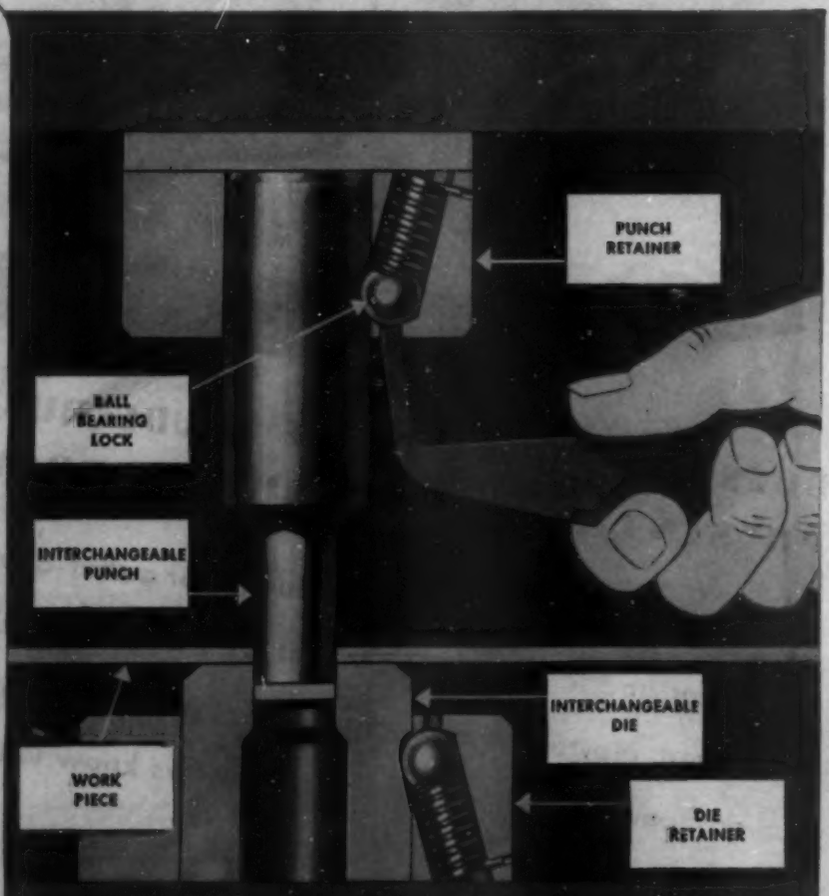
Precision Aircraft Parts . . . Plastic Molds . . . Interchangeable Punches and Dies . . . Production Parts Sheet Metal Dies . . . Jigs and Fixtures . . . Cold Forged Parts

BUY MORE WAR BONDS

The Original Interchangeable Punch and Die

Perfected by Richard Brothers Division of Allied Products Corporation, this unit is now widely used in all metal working fields. Standard size square, round or end retainers are of case-hardened steel. The retainer is fitted with a patented ball bearing and spring lock which holds the punch or die securely but permits easy changing without removing the die from the press. Interchangeable punches are of water-hardened steel, rigidly tested and inspected. Carried in stock in a wide range of standard sizes. Special size retainer plates, punches and dies made to order. Write for the complete R-B catalog.

"IT'S AN ALLIED PRODUCT"



Illustrated above is a complete Richard Brothers Interchangeable Punch and Die assembly showing the method of releasing either the punch or die simply by depressing the ball bearing with the special hand tool provided.

"SERVICE WITH A PUNCH"

How you can offer electronic industry better high frequency insulation at lower cost with STYRAMIC

OVER two years of use in high frequency electrical equipment have shown that Styramic has opened up a new and highly promising field to plastics . . . and given you a new and profitable opportunity to serve the electronics industry.

A modified polystyrene developed especially to overcome disadvantages of ceramics where high frequency insulating qualities are required, Styramic offers the following important advantages:

- ✓ the same superior high frequency electrical characteristics as polystyrene, most promising ceramic replacement previously available;
- ✓ excellent machining qualities;
- ✓ non-inflammability;
- ✓ better heat resistance than polystyrene, qualifying it for all applications except those where unusually high operating temperatures are encountered over a long time.

Manufacturers of high frequency equipment are especially interested in production economies made possible by Styramic. It can be readily molded by compression or injection and can be extruded into rods, tubes or other shapes of uniform cross section. It can be drilled, tapped or turned where machining is necessary to supplement molding. Unlike ceramic materials, it can be held to very close tolerances.

For full details and experienced technical assistance in adapting Styramic to war needs or postwar plans of you and your customers in the electronics industry, write: MONSANTO CHEMICAL COMPANY, Plastics Division, Springfield, Mass.

HOW STYRAMIC COMPARES WITH TYPICAL POLYSTYRENE	Styramic	A Typical Commercial Grade Polystyrene
Formulations and Colors	Styramic 28 Grey Styramic 20 Natural	Standard Crystal (water white)
Granulations, ins.	⅛	⅛
Screen Analysis Limits, % Through 3 mesh Through 14 mesh	 100 3	 100 3
Recommended Molding Method	Inj., ext. & comp.	Inj.
Compression Ratio	2.5-2.8	2.0-2.3
Molding Temperature, °F	325-450 inj. 300-350 comp.	300-400 inj.
Molding Pressure, lbs. per sq. in.	10,000 and up inj. 500 to 5,000 comp.	10,000 and up inj.
Specific Gravity	1.358	1.05-1.07
Specific Volume, cu. ins. per lb.	20.4	26.42
Mold and Age Shrinkage, ins. per in.	0.0025 after 6 mos.	0.0024
Heat Distortion, °F.	184-187	168-176
Flow Temperature, °F.	280	266
Water Absorption, 24 hrs., %	0.046	0.078
Burning Rate, ins. per min.	Chars slightly but will not burn	0.77
Tensile Strength, lbs. per sq. in.	3,000-3,500	6160
Flexural Strength, lbs. per sq. in.	6,000-7,000	13,100
Young's Modulus, in tension, p.s.i. x 10^5	3.34	3.18
Impact Strength, Izod, ft. lbs. per in. of notch	0.3	0.32
Rockwell Hardness	M72	M89
Dielectric Constant, 300 kc. dry	2.55	2.60
Dielectric Constant, 300 kc., 96 hrs. water immersion	2.60	2.60
Power Factor, 300 kc. dry	0.0004	< 0.0003
Power Factor, 300 kc., 96 hrs. water immersion	0.0004	< 0.0003
Loss Factor, 300 kc. dry	0.001	< 0.0008
Loss Factor, 300 kc. 96 hrs. water immersion	0.001	< 0.0008

The above values except where otherwise noted are determined on samples conditioned and tested at 25°C. (77°F.) and 50% R.H. A.S.T.M. standard test methods were used wherever applicable.

THE BROAD AND VERSATILE FAMILY OF MONSANTO PLASTICS

(Trade names designate Monsanto's exclusive formulations of these basic plastic materials)

LUSTRON (polystyrene) • **OPALON** (cast phenolic resin)
FIBESTOS (cellulose acetate) • **NITRON** (cellulose nitrate)
SAFLEX (vinyl acetal) • **RESINOX** (phenolic compounds)

Sheets • Rods • Tubes • Molding Compounds • Castings
Vuepak Rigid Transparent Packaging Materials

MONSANTO PLASTICS
SERVING INDUSTRY . . . WHICH SERVES MANKIND

Six At One Stroke!

By having an experienced and practical field engineer look over your sanding and finishing operations ***all six*** of these obvious benefits are instantly put at your service:

1. The most efficient of our five abrasives for cutting the specific material you're working.
2. The appropriate grit sizes for fast, long service and the best resultant finish.
3. The indicated coating of the abrasive crystals—Electro Coat, Openkote, Closekote. (They're vastly different, you know.)
4. The most effective and economical of our three backings—paper, cloth or "combination".
5. If cloth, just the optimum weight and flexibility; there are about a dozen gradations.
6. The most convenient form in which to buy—roll, sheet, belt, disc or several of the modern, ready-to-use "gadgets" for your portable or flexible shaft machines.

Knowledge of ***all six*** is vital to speed and economy. Get it from any of our branches or from BEHR-MANNING, Troy, N. Y.

Pioneers in Better Coated Abrasives Since 1872

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(DIVISION OF NORTON COMPANY)
TROY, N. Y.

BRANCHES: Boston, Buffalo, Chicago, Cleveland, Cincinnati, Grand Rapids, High Point, Indianapolis, Detroit, Los Angeles, New York, San Francisco, Philadelphia, St. Louis, Tacoma.

We can put our "know how" to work for you RIGHT NOW!

Do you have a post-war product on your drawing boards now that might be a whole lot better and cheaper to produce in molded plastics? Or a product in the model stage that is ready to go now. In either case we would like to talk to you.

We can't promise you deliveries right now, except on certain special items such as extruded tubing and cellulose nitrate sheets. But we can *deliver* when it comes to the application of plastic molding "know how" to the solution of your particular molding problem. Our engineers, backed by Auburn's more than sixty years of molding experience, can tell you, from your drawings or models, how and where plastics can best be used. More than that, they may be able to show you, before the die is made, how to increase your products saleability or profitability through a fuller use of Auburn's molding facilities and Auburn's experience.

Under the pressure of the last two or three years we have not only expanded those facilities but we have also piled up a lot of experience that is bound to make someone's peacetime products better and cheaper. It may be yours . . . so why not write now?

Services and Products Now Offered at Auburn

- Injection Molding
- Plastic Tubing
- Compression Molding
- Die Manufacture
- Extrusion
- Transfer Molding
- Cellulose Nitrate Sheets and Rods

MOLDED PLASTICS DIVISION

AUBURN

AUBURN BUTTON WORKS, INC., AUBURN, NEW YORK

PLASTICS

INCREASE PRESS WITH ELECTRONIC

Uniform Plasticity! Electronic preheating is so thorough that the entire preform becomes a spongy mass.

Quick Operation! No oven is required; the preforms are placed between two plates as shown here, and power applied for a few seconds.

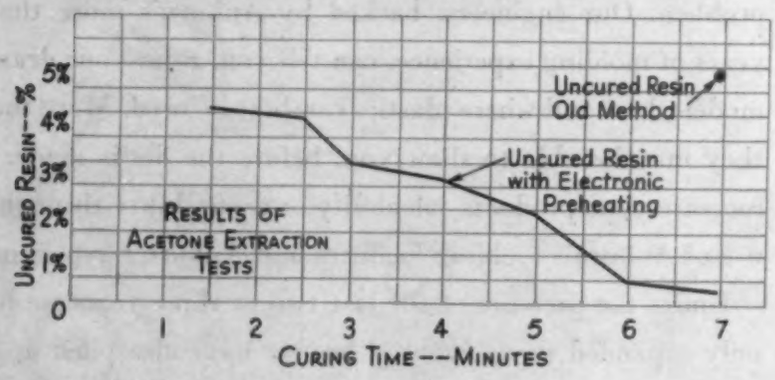
Uniform Heating Shortens Closing Time, Lowers Pressure Needed

Preforms heated with high-frequency power—generated by electron tubes—soften uniformly throughout. Temperature rises evenly. Thus electronic preheating can be very fast. It can be controlled with great accuracy.

A one-pound preform can be heated to 275°F. in about 60 seconds with an RCA 2-kilowatt electronic generator.

Faster Press Closing—Because of the high plasticity which this uniform heating provides, press closing is faster. In a typical case press closing time was reduced from 90 seconds to 20 seconds—a saving of 77%!

Faster Curing—Since the plastic material is uniformly preheated to a high temperature, the curing time in the mold is greatly reduced. Tests showed in one case a reduction of curing time from 7 minutes to 1½ minutes, while product quality (shown by acetone extraction) was improved.



Lower Pressures—The great plasticity obtained with electronic heat makes lower molding pressures possible than could be obtained with non-uniform heating.

Less Mold Stress—Easy flow of the plastic material decreases stresses on mold parts—especially in intricate molds—which means longer mold life, lower mold cost, and less danger of interrupting production due to damaged molds.

Improved Product—The low percentage of uncured resin obtained with electronic preheating makes for stronger products. The more uniform curing (or polymerization) of the plastic reduces residual stresses which cause warpage and distortion of the product. This means that better dimensional stability may be obtained.

Reduction of Rejects—Wherever rejects have been caused by irregular preheating, substantial reductions can be expected when electronic heating is used.

Overall Time-Saving—The time-saving possible with electronic heat will vary with different applications. In general, a reasonable estimate

OUTPUT 50% PREHEATING!

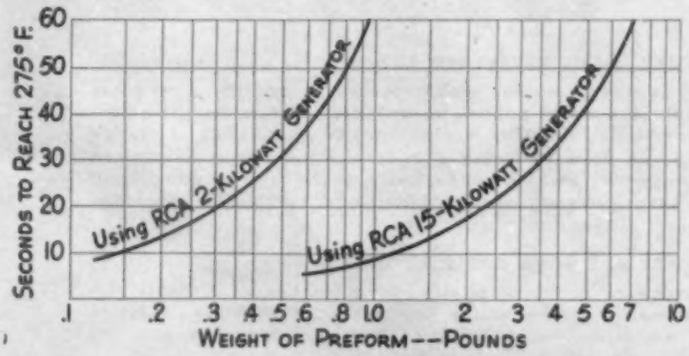
is that two presses will do the work of three—an increase of 50%—when electronic preheating is used.

Low Cost—Operation cost of RCA electronic heating for your product can be estimated at about one- to two-tenths of a cent per pound (for a top temperature of 275°F.). This figure includes tube cost.

How It Works—The RCA electronic generator converts ordinary electric current (60 cycles) into high-frequency alternating current (up to 10,000,000 cycles). This current is fed to the two plates between which the preform is placed (see photo, lower left).

The molding material becomes, in effect, an electrical conductor of this high-frequency current. Since the current distributes itself evenly, the heating it produces is uniform and thus can be very fast.

Estimating Power Needed—Assuming a maximum heating time of 60 seconds, the following table will help you choose the RCA units for your needs.



What Is Your Problem?—Electronic heating is still a relatively new science. For that reason your problem may be one that has not yet been solved. RCA engineers will be glad to help you in applying electronic heat in your plant, or to your plastic material if you are a materials supplier.

RCA engineers have prepared a simple engineering data form to help you supply information on your problem. Copies will be sent you promptly on request. Use the convenient coupon or write for "Engineering Data Form P," to RCA, Dept 70-31, Camden, N. J.

Convenient! Your RCA electronic generator can be placed to serve two or more presses. A safety cage protects your operators.

FREE (Please check)

☐ "Molding with Radio Frequency"—a 4-page article on electronic heating.

☐ "Engineering Data Form P"—an aid in stating your heating problem to RCA engineers.

RCA, Dept. 70-31
Camden, N. J.

Please send me the items checked.

*Name*_____

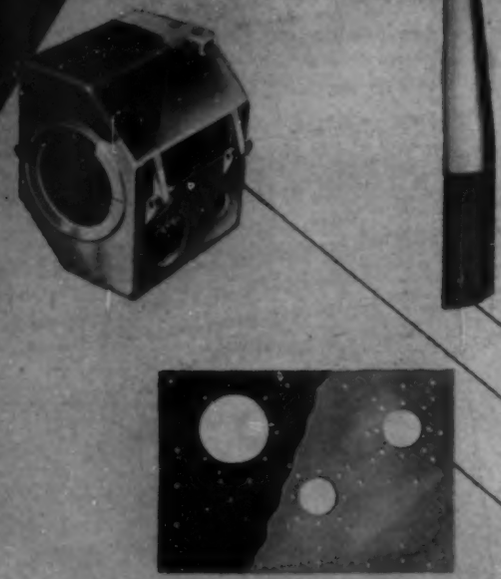
*Company*_____

*Street*_____

*City*_____ *State*_____

RCA ELECTRONIC HEAT
RADIO CORPORATION OF AMERICA

METAL PLATING *on Plastics*



WHAT IS THE METAPLAST PROCESS?*

It is a process for electroplating a smooth non-porous adhesive metal coating in any desired thickness, on non-conductive surfaces. Various metals or methods of plating can be used to insure one or a combination of desired properties of high conductivity, resistance to vibrational stresses, dimensional stability and elimination of moisture absorption.

WHAT ARE SOME APPLICATIONS?

A popular application of Metaplating is shown in the above photograph of a silver plated loop antenna. Metaplating provides a strong feather weight shield to eliminate precipitation static and to increase the "Q" of the loop.

Also shown is a thirty inch antenna mast used on combat planes. It is built of Compreg Wood and Metaplated with copper to Signal Corps specifications.

Pictured also is an electrostatically shielded housing Metaplated with a base coat of copper and finished with cadmium for corrosion resistance. Weight and expensive machine work are eliminated by the use of a light plastic for this complicated housing.

Easily printed and weight saving plastics can be used for instrument panels by Metaplating on the back any desired thickness of metal for grounding or electrostatic shielding.

The disc pictured at left is an example of a combination insulating and conducting surface Metaplated in specific areas for control of precise electrical equipment.

Write or wire our Engineering Department concerning your problem.

Metaplast

**U.S. Patents 2,214,646-2,303,891 U.S. and Foreign Patents*

METAPLAST CORPORATION 205 WEST 19th STREET ★ NEW YORK 11, N. Y.

Success IN PLASTIC MOLDING STARTS WITH THE MAKING OF *Molds!*

Elmes Builds a Complete Line of Hobbing Presses, Ranging Up to the Heaviest Capacities. Each Combining Features of Efficiency, Safety, and Smoothness in Power Application . . .

ELMES
HYDRAULIC HOBBING OR DIE SINKING PRESS
3-column, motor driven, compact in design, made of highest quality materials throughout.

Important to the success of any manufacturing operation is the foundation work upon which production routine is based.

Nowhere is this more vital than in the making of molds.

Consequently, the accuracy of operation plus the precision control of this Elmes Hobbing Press has made it preferred equipment for plastic mold manufacturers.

Elmes Engineering Staff will gladly cooperate with you in the selection of a hobbing press to meet your specific requirements. Suggestions, recommendations, with cost estimates will be given without obligation.

ELMES ENGINEERING WORKS *of* AMERICAN STEEL FOUNDRIES, 225 N. Morgan St., Chicago

FEATURES THAT GUARANTEE OUTSTANDING PRESS PERFORMANCE

- CONTROLLED HOBBING SPEED
- RAPID ADVANCE TO AND FROM WORK
- SIMPLICITY AND EASE OF OPERATION
- RUGGED CONSTRUCTION
- FULLY ENCLOSED
- SHATTER-PROOF GLASS SHUTTER

Free Bulletin . . .

"HYDRAULIC PLASTIC MOLDING PRESSES"

Recently printed, this bulletin describes the presses used for compression and transfer molding processes. Send for your *free* copy today.

ELMES HYDRAULIC EQUIPMENT

Also Manufactured in Canada

METAL-WORKING PRESSES · PLASTIC-MOLDING PRESSES · EXTRUSION PRESSES · PUMPS · ACCUMULATORS · VALVES · ACCESSORIES

BEHIND all of our modern methods of communication are electrically energized devices. Their successful operation depends on good insulating materials, insulating materials that will take physical abuse and which will function under extreme moisture and temperature conditions.

Ever since electrical energy was first harnessed and put to work C-D materials have provided good insulation. The development of better insulating materials has been the constant goal of the C-D laboratory. The success of C-D's efforts have been the lengthening shadows which have forecast the phenomenal advances which this country has made in the field of communications.

1st DIAMOND Vulcanized FIBRE; then DILECTO, a moisture proof insulation; 3rd VULCOID, which combines to a remarkable degree the desirable properties of both DIAMOND Fibre and DILECTO; 4th MICABOND—Mica insulation in its most usable form and now DILECTENE, a pure resin plastic especially for U-H-F insulation.

C-D engineers have helped solve thousands of insulating problems. They have accumulated a wealth of "know how" which is at your disposal to help solve your electrical insulation problem.

DISTRICT OFFICES: New York - Cleveland - Chicago - Spartanburg, S. C. West Coast Rep., Marwood, Ltd., San Francisco - Sales Offices in principal cities

C-D products include THE PLASTICS... DILECTO—a laminated phenolic; CELORON—a molded phenolic; DILECTENE—a pure resin plastic especially suited to U-H-F insulation... THE NON-METALLICS, DIAMOND Vulcanized Fibre; VULCOID — resin impregnated vulcanized fibre; and MICABOND—built-up mica insulation. Folder GF describes all these products and gives standard sizes and specifications.

CH-43

Continental - Diamond FIBRE COMPANY

Established 1895 . . Manufacturers of Laminated Plastics since 1911 — NEWARK • DELAWARE

SPEEDING THROUGH the projector, movie film must be flexible—and tough. It is made of Cellulose Nitrate or Cellulose Acetate.

WIRE INSULATION of extruded Ethyl Cellulose is highly flexible, extremely tough —and has excellent dielectric properties.

FLEXIBLE BRISTLES for paint brushes are made by Devoe & Raynolds with a coating of Cellulose Acetate over rayon cord.

WHEN IS A PLASTIC TRULY *FLEXIBLE*?

It is not just by chance that movie film is made of Cellulose Nitrate or Cellulose Acetate . . . or that the Signal Corps' identity panel for motorized Army equipment is coated with Ethyl Cellulose. Flexibility is a prime characteristic of plastics based on cellulose compounds —they are truly *flexible*, over wide ranges of temperature.

If your product must, like those pictured here, withstand flexing or bending, twisting or folding, an inquiry among those who make plastics will most likely lead to one of the Hercules derivatives of cellulose. We do not ourselves make plastics, but through years of research as a leading producer of cellulose compounds we have developed each of the properties which give cellulose plastics their unique combination of advantages. For literature and other data, we invite you to write to Cellulose Products Dept., MP-14,

Hercules Powder Company, Wilmington 99, Del.

ECONOMICAL • CLEAR • STABLE • FLEXIBLE • TOUGH • LIGHTWEIGHT

TO IDENTIFY U. S. equipment to U. S. aircraft, these brilliant fluorescent panels, coated with Ethyl Cellulose. No cracking or peeling at 20° F below zero — no stickiness even at 200° F. Developed by Conti-Glo Division, Continental Lithograph Corporation.

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HERCULES

CELLULOSE ACETATE
CELLULOSE NITRATE
ETHYL CELLULOSE

Post War PLASTIC Sales

... A sound capital structure is required to finance broad post war markets. Alert management is investigating factoring — the streamlined banking of prosperous industry.

BOOKLET ON REQUEST

COLEMAN & COMPANY

FACTORS · ESTABLISHED 1912

468 FOURTH AVENUE • NEW YORK CITY

METAL PLATED PLASTICS
FOR INCREASED
DIMENSIONAL STABILITY

● Imagine cellulose acetate (metal plated) withstanding temperatures up to 203° F. without blistering or deformity! An unplated specimen of the same quality showed deformity at 165° F. This test and others in our laboratory have proved that METAL PLATED PLASTICS effectively combat dimensional instability from either heat or cold flow.

The Monroe method of plating plastics with metals also contributes to *flexural strength, electrical shielding, impact strength*... and helps control absorption. It opens a wide new range of possibilities in the use of plastics... particularly thermoplastics.

Our long experience of more than a quarter of a century in the production of countless metal products for many companies is your assurance that we recommend plated plastics only where a genuine advantage over the use of metals is apparent.

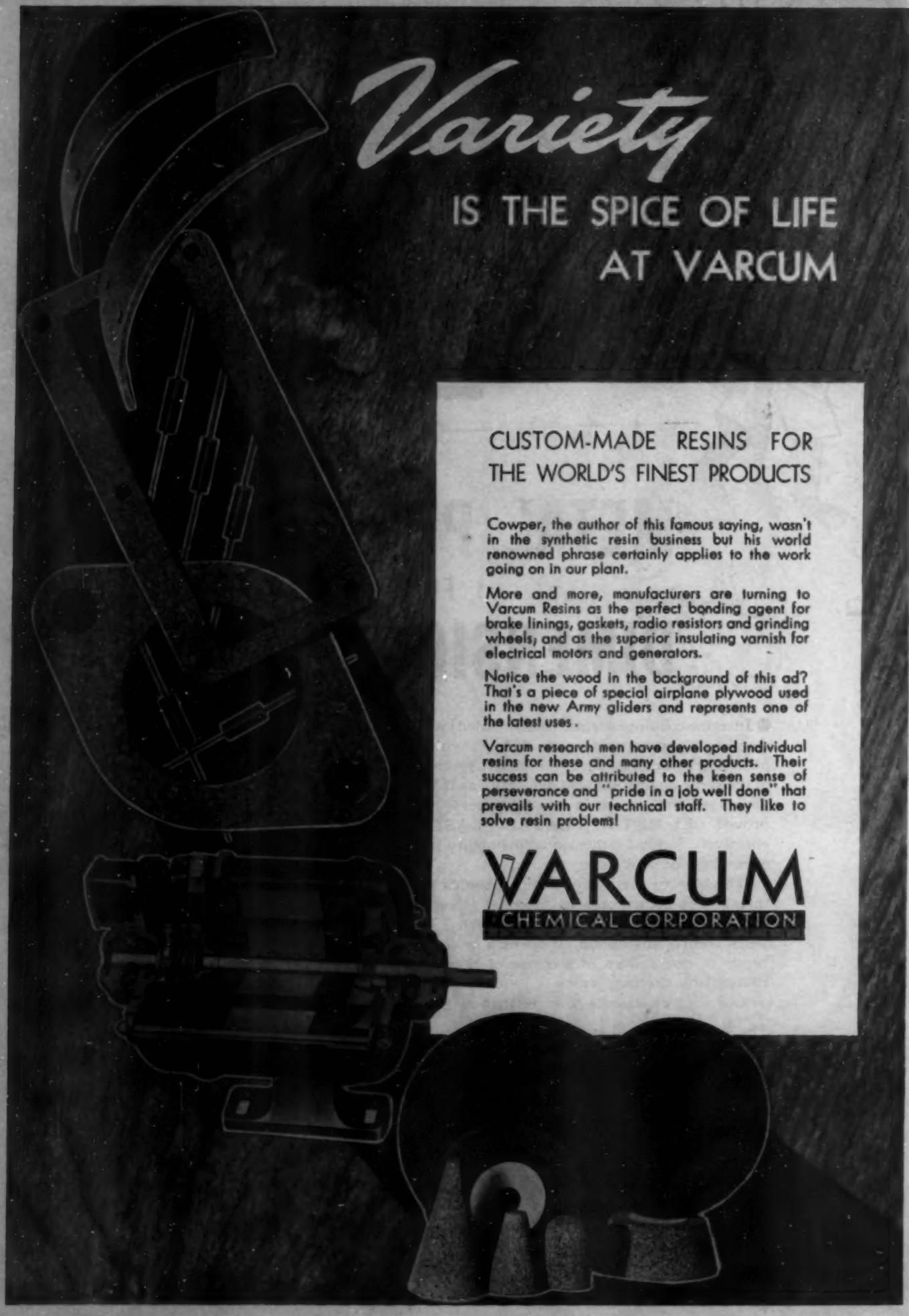
By our process, plastics can be successfully plated with any metal that lends itself to electroplating, and through experimentation has revealed an extensive range of applications.

We are prepared to work with your designers and engineers immediately to determine applications of METAL PLATED PLASTICS in your own field of manufacture.

Write for our bulletin giving you further information on "Plated Plastics."

WHEN YOU THINK OF METAL PLATED PLASTICS, THINK OF—

MONROE AUTO EQUIPMENT COMPANY
PLASTICS DIVISION
MONROE, MICH.
The Metaplast Process


Variety
IS THE SPICE OF LIFE
AT VARCUM
CUSTOM-MADE RESINS FOR
THE WORLD'S FINEST PRODUCTS
Cowper, the author of this famous saying, wasn't in the synthetic resin business but his world renowned phrase certainly applies to the work going on in our plant.
More and more, manufacturers are turning to Varcum Resins as the perfect bonding agent for brake linings, gaskets, radio resistors and grinding wheels; and as the superior insulating varnish for electrical motors and generators.
Notice the wood in the background of this ad? That's a piece of special airplane plywood used in the new Army gliders and represents one of the latest uses.
Varcum research men have developed individual resins for these and many other products. Their success can be attributed to the keen sense of perseverance and "pride in a job well done" that prevails with our technical staff. They like to solve resin problems!
VARCUM
CHEMICAL CORPORATION

The Munising Paper Company

GENERAL SALES OFFICES • 135 SOUTH LASALLE STREET • CHICAGO, ILLINOIS

U N I F O R M I T Y

The word "uniformity," like "service," is a general, abstract term often abused, seldom defined. When we speak of uniform paper at MUNISING, however, we do have in mind certain definite specifications for the plastics laminating industry and they are as follows:

Uniform Absorbency - Under identical impregnating conditions MUNISING'S papers should absorb the same amount of resin throughout the run and in successive runs.

Uniform Density and Caliper - Manufacturing tolerances are based on a maximum variation of plus or minus 2-1/2% for both caliper and weight. This also assures a uniformity of density which might not be obtained where paper is manufactured only to a definite specification of caliper.

Uniform Formation - An even distribution of fibers is helpful in obtaining an even impregnation. If fibers lump together, making what is known as a "wild" sheet, even impregnation is difficult.

When we state that our precision method of manufacture makes uniform paper, we have in mind uniformity as it applies to the above mentioned characteristics, not only throughout each run but in each successive run. Should this type of precision manufacture be of interest, may we suggest you contact us.

THE MUNISING PAPER COMPANY

Executive Offices:
135 South LaSalle Street
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MANUFACTURERS OF PRECISION MADE PAPERS FOR MORE THAN FORTY YEARS

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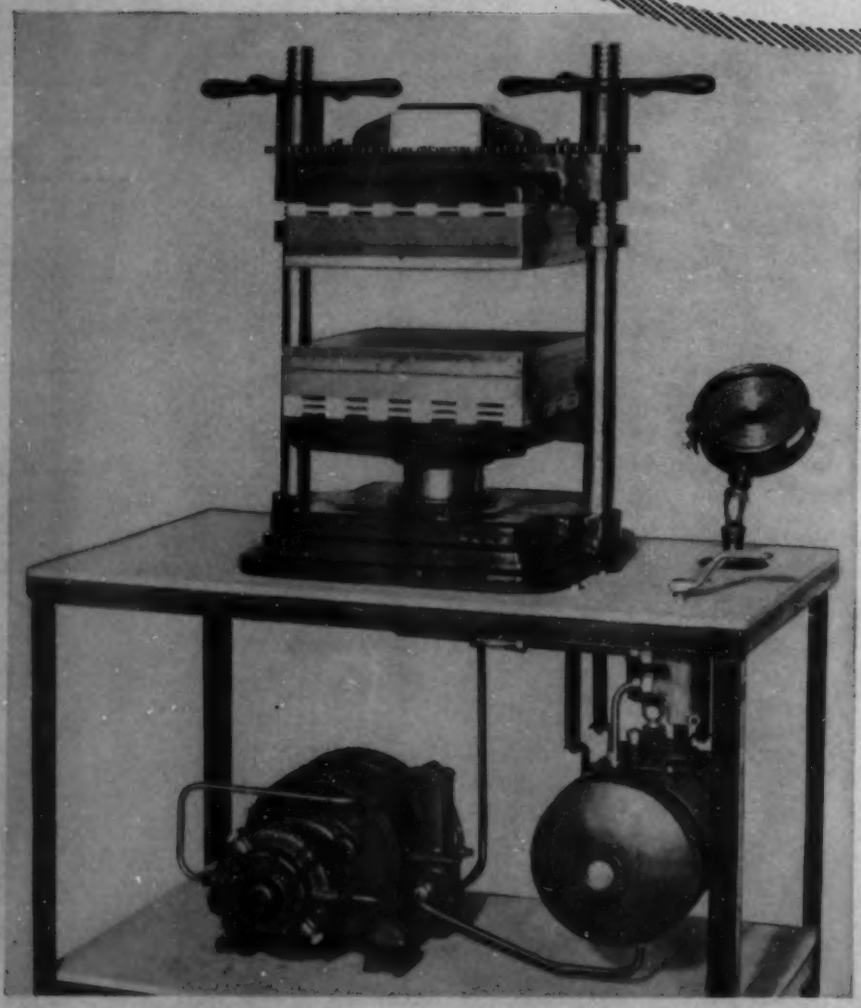
For Laboratory and Production Presses



Williams Apparatus Co.
Laboratory Press
powered with HYCON Units

Small Compact Elements
Operation 0 p.s.i. to 3000 p.s.i.

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Engineering Assistance without obligation

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ON REQUEST

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THE NEW YORK AIR BRAKE COMPANY

Hydraulic Division

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NORTON LABORATORIES (INCORPORATED)

CUSTOM MOULDERS OF SYNTHETIC PLASTICS
BAKELITE DUREZ

LOCKPORT, N.Y.

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ALL AGREEMENTS ARE CONTINGENT UPON STRIKES, FIRES, ACCIDENTS OR CAUSES BEYOND OUR CONTROL.
CONTRACTS WITH AGENTS NOT VALID UNTIL APPROVED BY AN OFFICER

January, 1944

Readers:

There was an old lady
Who lived in a shoe,
She had so many children
She didn't know what to do.

The old widow undoubtedly had a time of it and we in the Plant Engineering and Maintenance Department can sympathize with her. We have a lot of problem children ourselves, being sort of in the middle between the other departments in the plant and our customers.

I have found out one thing that might interest you and that is that in these days when it takes almost an Act of Congress to get equipment and repair parts, our gang here at Norton Laboratories really knows how to cut corners and get things done with a minimum of time, money and equipment. I don't say we accomplish the impossible, but we have set aside many an improbable.

We thought you would like to know what we have found out about our own co-workers because it might mean something to you when, at some future date ten minutes or ten months from now, you might come up with a few problem children yourself. If it has to be done in plastics or if plastics might help save the day, just shoot it our way and we think we will be able to help you.

Very truly yours,

Alan A. Sim

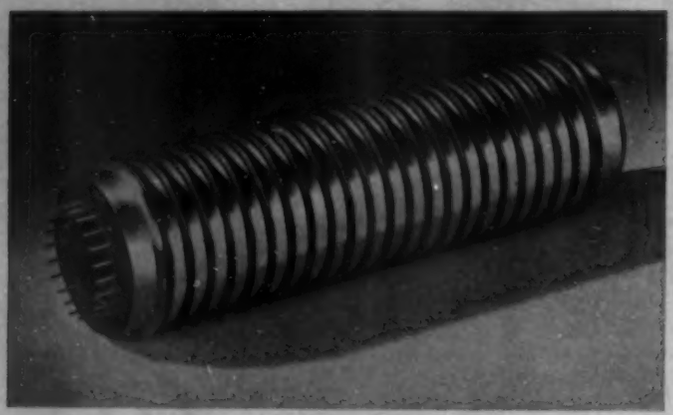
Alan A. Sim
Plant Engineer

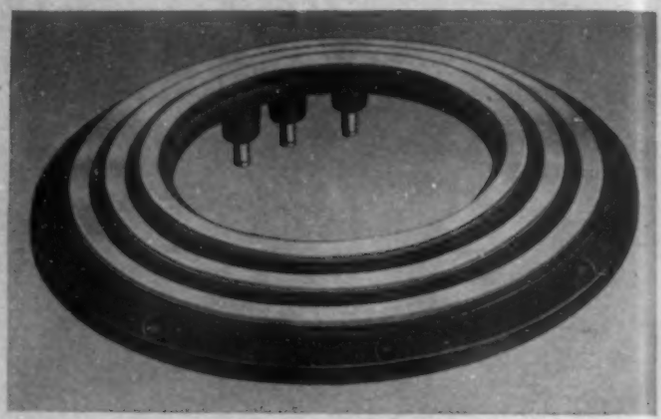
Collaborating closely with the engineering staffs of manufacturers engaged in producing for America's military requirements, this organization has specialized in the redesign of products and parts to assure maximum benefits through the use of plastic materials and plastic molding. Our engineering experience and molding facilities will be

PM

THE SYMBOL OF ENGINEERING EXPERIENCE AND MOLDING SKILL

available to serve post-war industry in similar degree; assisting in product betterment, in reducing assembly time, in lowering cost of manufacture . . . in the most practical application of plastics to products old or new. The molded plastic assemblies described below illustrate some of our precision molding and assembly services.





EXEMPLIFYING FUNCTIONAL DESIGN IN PLASTICS

MOLDED PLASTIC ROTORS above are made in one-piece with 22 rings and 3 rings respectively. Bi-metal rings are precisely spaced and transfer-molded in a material selected by our research engineers to provide balanced physical and electrical properties. Permanent alignment is assured through one-piece construction, with consequent elimination of assembly and service problems. Our molded finish is more moisture-resistant than a machined surface with consequent reduction in power loss.

CONTROL PULLEYS . . . molded complete with ball-bearings to eliminate the need for metal bushings. This avoids variations that may occur when bearings must be fitted to bushings and saves assembly time. Mold finish of groove is smoother and harder than machined surfaces, which serves to prolong cable life. Pulleys are molded from a phenolic compound, reinforced by macerated fabric for greater durability.

MOLDED CONNECTOR PANEL ASSEMBLIES
As suppliers of molded plastic parts to the aircraft industry, one of our services is the manufacture of connector panels, molded and assembled complete with hardware. These are delivered cut to desired lengths and ready for use. Assembly time is saved. Loss from scrap is avoided. The assemblies are available in 2 types: NAS 17 and NAS 18.

Write for free FOLDER FILE, containing more complete information on our plastics designing and molding services.

PLASTIC MANUFACTURERS

INCORPORATED

INJECTION AND TRANSFER MOLDING

STAMFORD, CONNECTICUT

50 to 3000

Pounds Pressure from your Present Hydraulic Circuits

with a

RACINE

Hydraulic Pressure BOOSTER

A high pressure, oil hydraulically actuated, compact, self-contained auxiliary to your present low pressure hydraulic circuit. Increases your source of force as much as 7 to 1. Creates new standards of flexibility and operating economy.

FOR NEW OR OLD HYDRAULIC CIRCUITS. Fits anywhere into your present or new hydraulic circuits without interference. Now you can obtain *high pressure when you need it—return to low pressure at will.* Use low horsepower motor and low pressure control valves—results in lower initial investment and reduced operating and maintenance costs.

Can be used in circuits with either variable or constant volume pumps.

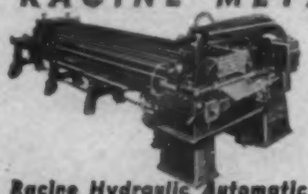
Free from repairs — no gears to wear out — no driving mechanism to get out of adjustment. The Racine Hydraulic Pressure Booster is an exclusive patented unit. For complete information ask for illustrated bulletin. Address Dept. MP-P.

"Variable Volume" PUMPS
"Balanced-Piston" VALVES

Include in your hydraulic circuits Racine Oil Hydraulic "Vane Type-Variable Volume" Pumps. Capacities 12 - 20 - 30 G.P.M. Operating pressures 50 to 1,000 pounds per square inch. Racine "Balanced-Piston" Valves insure ease of operation. Sizes ⅜" to 1½". Available with manual, solenoid, pilot and mechanically operated devices. Let Racine engineers help you with your oil hydraulic applications. Ask for Bulletin P-10-C.

Racine "Variable Volume" Oil Hydraulic Pump

RACINE METAL CUTTING MACHINES



Racine Hydraulic Automatic Stock Feed Machine

For 36 years Racine has led the field in metal cutting machines. Positive screw feed and the application of hydraulic operation, feed and control to metal cutting machines of the reciprocating type, were first developed by Racine. A full line—capacities 6" x 6" to 20" x 20".

RACINE
TOOL and MACHINE COMPANY
Standard for Quality and Precision
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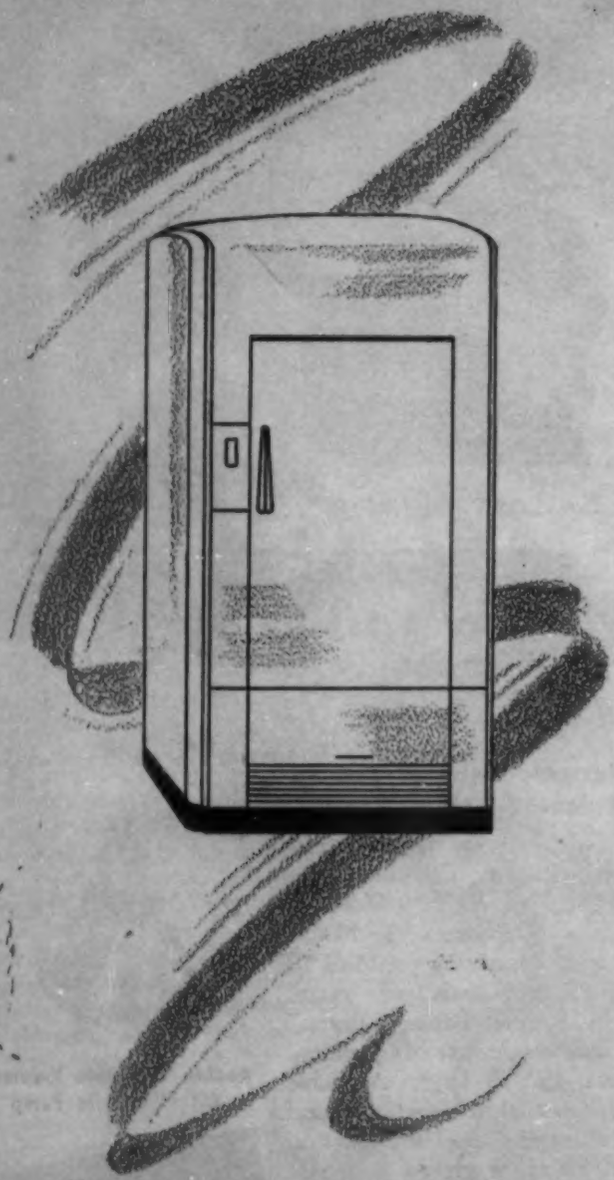
TOMORROW'S REFRIGERATOR MADE WITH PAPER



In the meantime, Riegel-X is being used for gunners' seats, wing tip ribs, ammunition boxes, helmets and many other military purposes.

In a world with plenty of metal, post-war refrigerators will be made with Riegel-X plastic laminates.

The logic of this revolutionary practice is beyond question. Instead of being a conductor—Riegel-X has high thermal and electrical insulation. It is light in weight and very strong—reducing cost of shipping and installation, and lessening the chance of damage in transit. It lends itself to stream-lined production methods with consistency of quality and perfection of detail.

Refrigerators are only one example. Other post-war products are being developed because Riegel-X is water-proof, termite proof, will not support combustion, and can be fabricated into complicated shapes.

Now is the time to find out where Riegel-X fits into your post-war plans. Write for information and samples to

RIEGEL PAPER CORPORATION
342 MADISON AVENUE, NEW YORK 17, N. Y.

RIEGEL-X

X A group of plain and impregnated base papers for both fluid and direct pressure plastic laminates X

LESTER

Three Machines in One

AND TIME-TESTED, TOO!

If you produce thermoplastic moldings, you are probably thinking right now about your future products. And that brings you immediately to molding machines. It is difficult to know exactly what products you will be making. That means that you want the most versatile molding equipment you can get.

Consider this about Lester Injection Molding Machines. The size range is complete—4, 6, 8, 12, 16 and the 22-ounce size for larger moldings. The operating range is greatly extended by the interchangeability of *three* heating cylinders of different capacities available for each *model.* Thus the Lester is three machines in one, for each model is capable of operation in *three* ranges.

Lester Injection Molding Machines are modern, for they are designed* for today's requirements of speed, accuracy and economy. But they are time-tested, too. Lesters are the result of more than three decades of experience in the engineering design of pressure casting equipment.

In the markets of the future, you'll face the competition of these versatile molding machines. Isn't it wise to investigate the Lester line *now?*

The 22 OUNCE LESTER

The 22-Ounce Lester—senior member of the family in point of size. Designed against a background of long experience, this newest Lester Injection Molding Machine has proved its ability to produce high quality moldings in more than 2 years of service in actual production operation.

* REASONS WHY LESTERS DO *MANY* JOBS WELL

1. Vertical heating cylinder with hollow injection plunger for high heating efficiency.
2. Extra, interchangeable heating cylinders for maximum operating range.
3. Flash on moldings held to absolute minimum by positive die locking.
4. Perfect parallelism of die plates assured by central die adjustment.
5. Die locking mechanism rigidly supported by heavy alloy steel beam frame.
6. Complete range of sizes, from 4 to 22 ounces.

National Distributors: **LESTER-PHOENIX, INC.**
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LESTER

INJECTION MOLDING MACHINES

Be First ON THE POST-WAR PRIORITY LIST

Post-war employment and prosperity depend upon quick resumption of normal peace time civilian activities, production, and services. To furnish lathes first to those who will be ready to use them (but cannot qualify for a war-time priority) South Bend Lathe Works now offers a practical post-war priority plan.

To take advantage of this plan, place an order now for the lathes you want. No down payment, no deposit is required. Should conditions necessitate, you may cancel the order at any time. All we ask is that it be placed in good faith.

When your order is received, we will issue a numbered Post-war Priority Certificate. As soon as materials and manpower are released for civilian production, South Bend Lathes will be shipped in accordance with the Priority Certificates. Certificate holders will receive the first South Bend Lathes to be thus released, up to 80% of our production. The remaining 20% will be reserved for returning service men who may need lathes.

All standard South Bend Lathes, embodying the improvements developed in meeting exacting war production needs, will be available. No revolutionary models or design changes are to be expected. There will be no price increase—unless material or labor costs, or other conditions beyond our control, require it.

Here is a practical first step in putting your post-war plans into action. Send for Catalog No. 100-C and full information on this plan. Choose the lathes that meet your needs... place an order now, and be sure of earliest possible delivery.

South Bend Engine Lathes and Toolroom Lathes are made in five sizes: 9", 10", 13", 14½", and 16" swings, with bed lengths from 3' to 12'. The Turret Lathes are made with 9" and 10" swings. They are illustrated and described in Catalog No. 100-C.

SOUTH BEND LATHE WORKS

SOUTH BEND 22, INDIANA • LATHE BUILDERS FOR 37 YEARS

14½" South Bend Lathe Bed Lengths: 5' to 10' | 13" South Bend Lathe Bed Lengths: 4' to 7' | Series 1000 South Bend Turret Lathe, 10" Swing | 9" South Bend Lathe Bed Lengths: 3' to 4½' | 10" South Bend Lathe Bed Lengths: 3' to 4½' | 16" South Bend Lathe Bed Lengths: 6' to 12'

Simple looking item, isn't it? Just a plain plastic bushing, about the size of a wedding ring. But it took a lot of plastic experience to lay out and make the mold to press it most rapidly and economically, *with inside and outside diameters concentric, and held to tolerances of .004".*

That experience goes as far back of presses and mechanical equipment as successful military operations go back of planes and tanks and guns. It calls for detailed knowledge of the history and workings of plastics . . . failures as well as successes.

Any plastic job requires first, ability to decide if it *is* a plastic job. Then the specifications must take into account the characteristics and peculiarities of the many kinds of plastic materials. Only when these points are determined does the time come for designing and making molds (which we always prefer to do ourselves) and putting the job on the presses.

That's the kind of experience you meet at General Industries. If you will tell us what you want plastics to do, we'll put our experience to work. We'll suggest the right material. We'll design and make your molds. We'll meet our delivery promises. (Or, we might tell you that we think it is NOT a plastic job.)

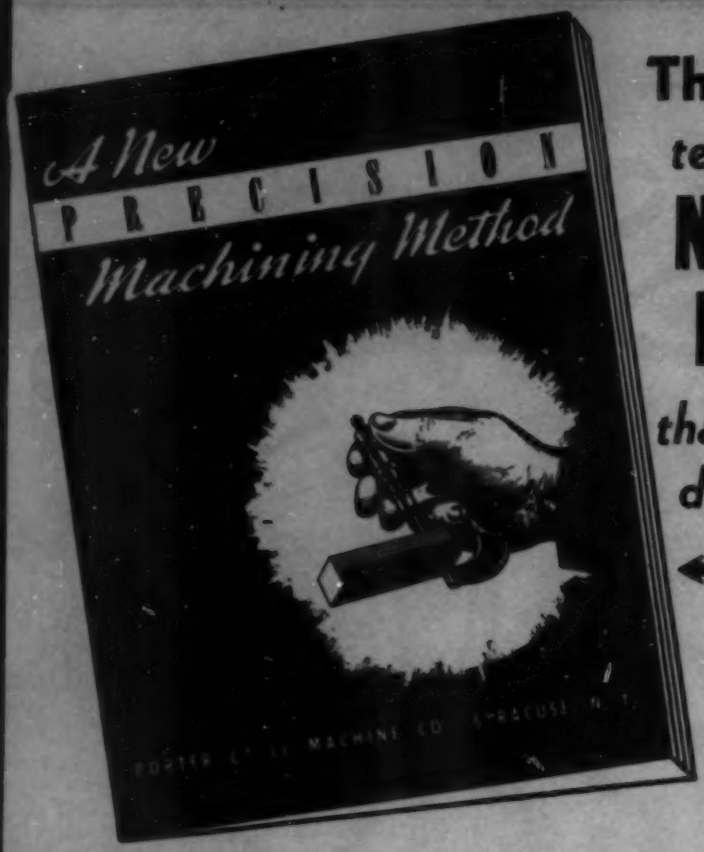
Right now, our equipment is working on Uncle Sam's priorities. But when Victory is won we'll be ready to put our experience and facilities to work for you.

THE GENERAL INDUSTRIES COMPANY

MOLDED PLASTICS

Molded Plastics Division • Elyria, Ohio

Chicago: Phone Central 8431
Detroit: Phone Madison 2146
Milwaukee: Phone Daly 8818
Philadelphia: Phone Camden 2215



This Valuable Book

tells you all about a

NEW Finishing METHOD...

that eliminates flow, chipping discoloration, fracturing . . .

MODEL G-8

MODEL B-6

(Vertical & Horizontal) MODEL G-4

● By employing abrasive belts of greatly advanced cutting power, plus effective coolants, plus machine features that permit holding close tolerances—.0005" when desired—Porter-Cable now provides you with an amazingly efficient and economical means of solving the various problems of plastic finishing.

By flushing the belt before *and* after it passes over the work, heat and dust are positively eliminated, and with them all possibility of flow, distortion, discoloration. There is no danger of weakening or breaking down materials of low fusion point. The grindings never "weld" to the grit and load the belt, nor form a burr on the piece.

On certain Porter-Cable models, the flexibility of the belt allows it to follow contours, and to reach into places inaccessible to other power tools. Suitable backing plates for repeat operations turn out curved and irregular work with unprecedented precision at production-line speed.

● If you have a finishing problem of any sort, the complete story of Wet-Belt Surfacing should be of great interest to you. It's told in our new booklet, "A New Precision Machining Method." Use the coupon to send for your copy today.

PORTER-CABLE MACHINE COMPANY

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Porter-Cable Machine Co.
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Please send me a copy of "A New Precision Machining Method."

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Company.....

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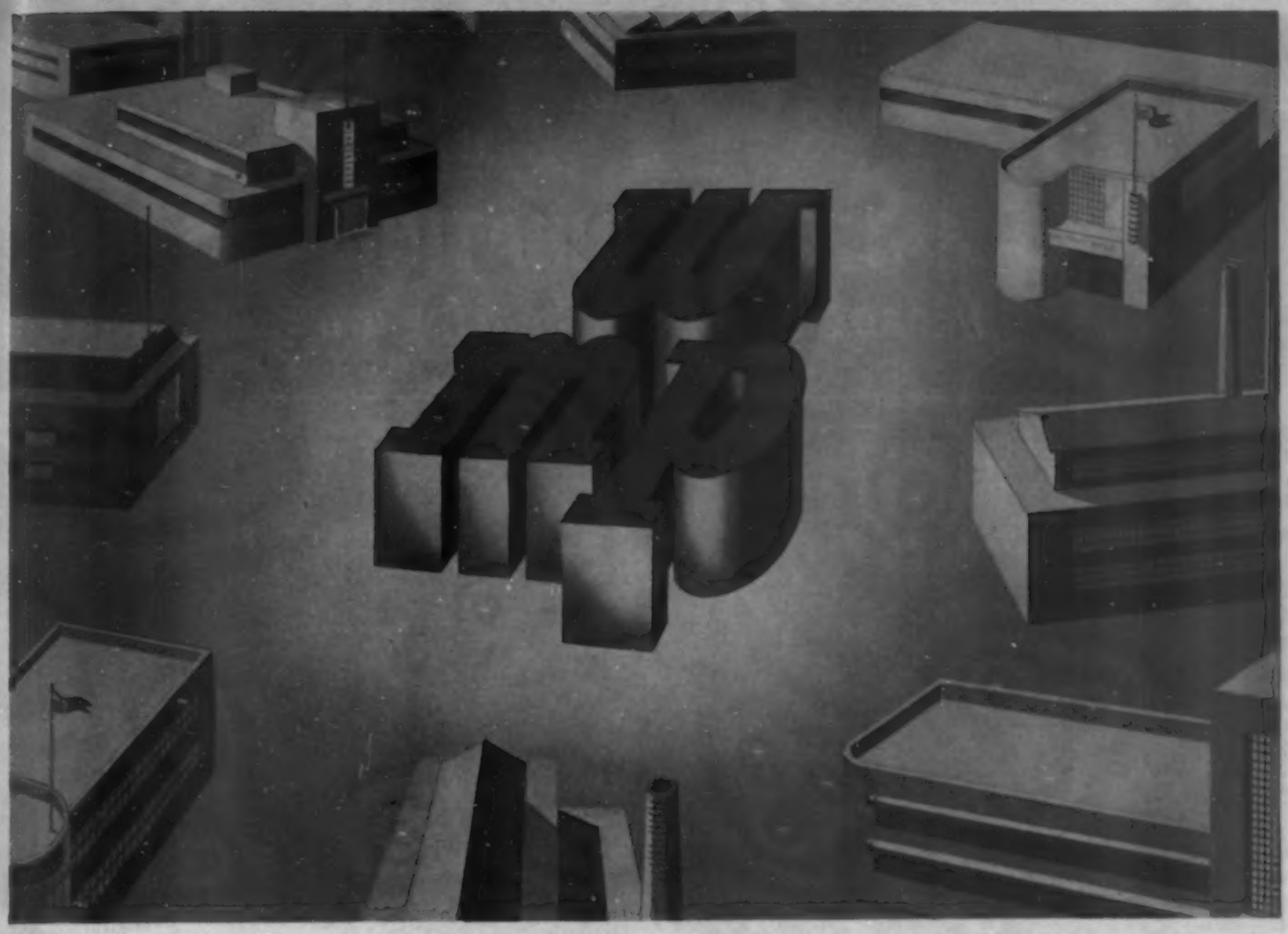
City.....State.....



A Growing Center of Interest ...in PLASTICS

The minute plastics come to mind in connection with your own manufacturing, you have only to turn to the skilled, experienced and exceptionally well equipped Worcester Moulded Plastics Co.

Your own requirements become our number one concern. As custom injection moulders, we are in a position to concentrate our knowledge to the full on your individual plastics problem or inquiry — to determine whether our injection moulding or some other method provides the answer.

As a creative, engineer-trained and service-minded organization, we are ready today, to talk about tomorrow's application of plastics with any executive who reads MODERN PLASTICS.

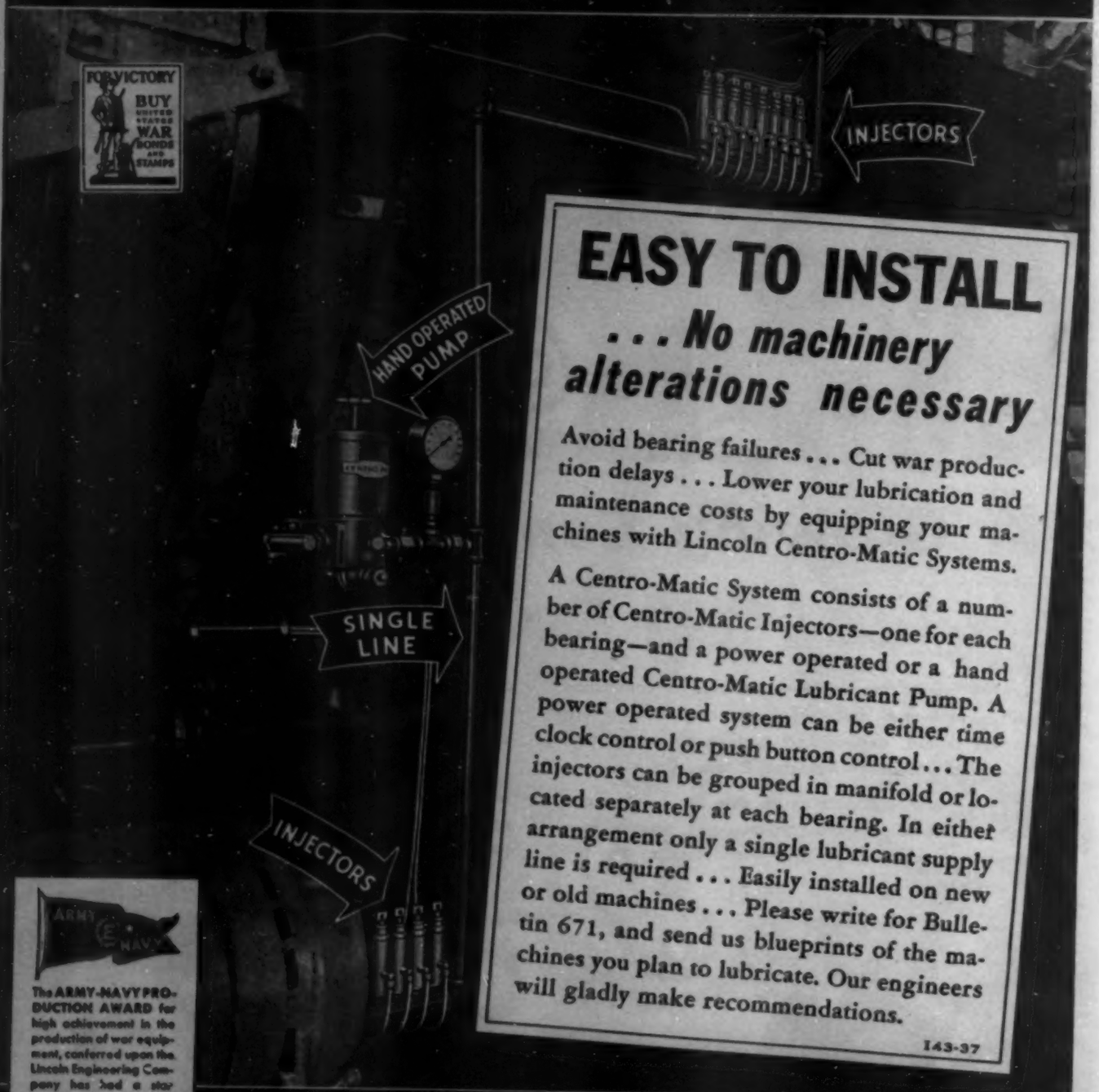
For Custom Injection Moulding . . . try the Trio

8 GRAFTON ST., WORCESTER, MASS. 17 E. 42nd ST., NEW YORK, N.Y.

LINCOLN

CENTRO-MATIC LUBRICATING SYSTEM

supplies lubricant to every bearing on a machine



EASY TO INSTALL

. . . No machinery alterations necessary

Avoid bearing failures . . . Cut war production delays . . . Lower your lubrication and maintenance costs by equipping your machines with Lincoln Centro-Matic Systems.

A Centro-Matic System consists of a number of Centro-Matic Injectors—one for each bearing—and a power operated or a hand operated Centro-Matic Lubricant Pump. A power operated system can be either time clock control or push button control . . . The injectors can be grouped in manifold or located separately at each bearing. In either arrangement only a single lubricant supply line is required . . . Easily installed on new or old machines . . . Please write for Bulletin 671, and send us blueprints of the machines you plan to lubricate. Our engineers will gladly make recommendations.

143-37

ARMY E NAVY

The ARMY-NAVY PRODUCTION AWARD for high achievement in the production of war equipment, conferred upon the Lincoln Engineering Company has had a star added. This star symbolizes 6 more months of exacting service to our Armed Forces, delivering vital materials so necessary for ultimate Victory.

LINCOLN ENGINEERING COMPANY

Pioneer Builders of Engineered Lubricating Equipment

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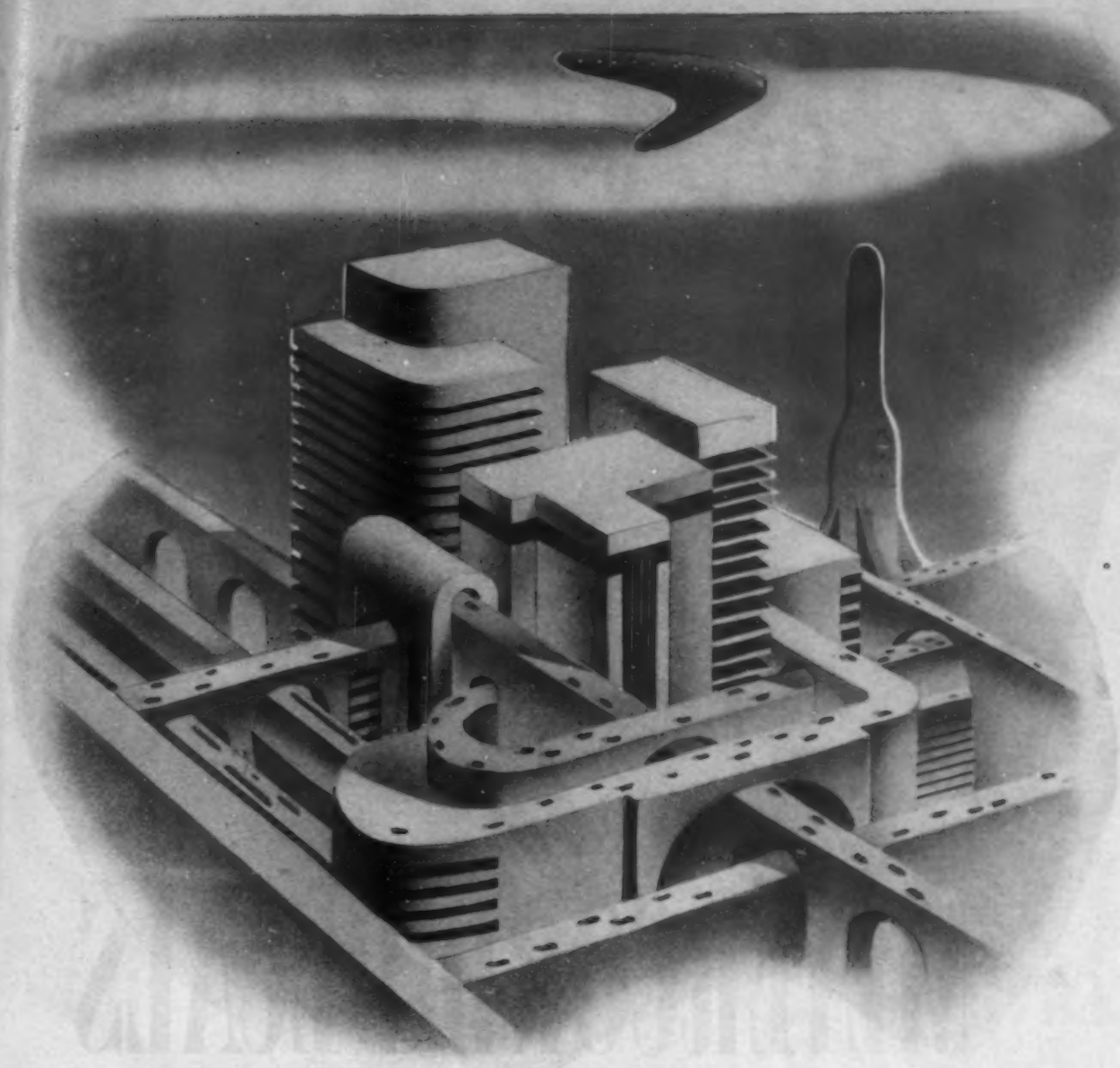

Tomorrow's World

Today most of us are planning for the future . . . for the world of tomorrow. Some of these plans are still in the minds of designing engineers . . . others have advanced through the drawing board stage.

It has been our privilege to assist in the actual development of some of these ideas and plans and to suggest where and how plastic parts can be used to advantage. The resources and experience of our company are available to manufacturers who are thinking in terms of postwar production.

THE PYRO PLASTICS COMPANY

WESTFIELD • NEW JERSEY

Decorated FOR ACTION ON THE SALES FRONT...

with MEYERCORD DECALS

Meyercord Decals add decorative charm to plain plastic surfaces . . . brilliance and eye-catching sales appeal that spells sales action . . . with permanence that insures lasting beauty and identity. Meyercord Decals provide an unlimited range of color and design for either package or product use. They are durable, washable and economical to use. Special production line techniques permit speedy, low-cost application to flat or curved surfaces. Special methods insure adhesion to various resins. Reasonable quantities of stock designs are available for current use. For postwar products now in the blueprint stage, Meyercord offers confidential and expert technical counsel on any plastic-ware decorating problem. Address your inquiries to Department 211.

Back the Attack - Buy War Bonds

THE MEYERCORD CO.

World's Leading Decalcomania Manufacturer

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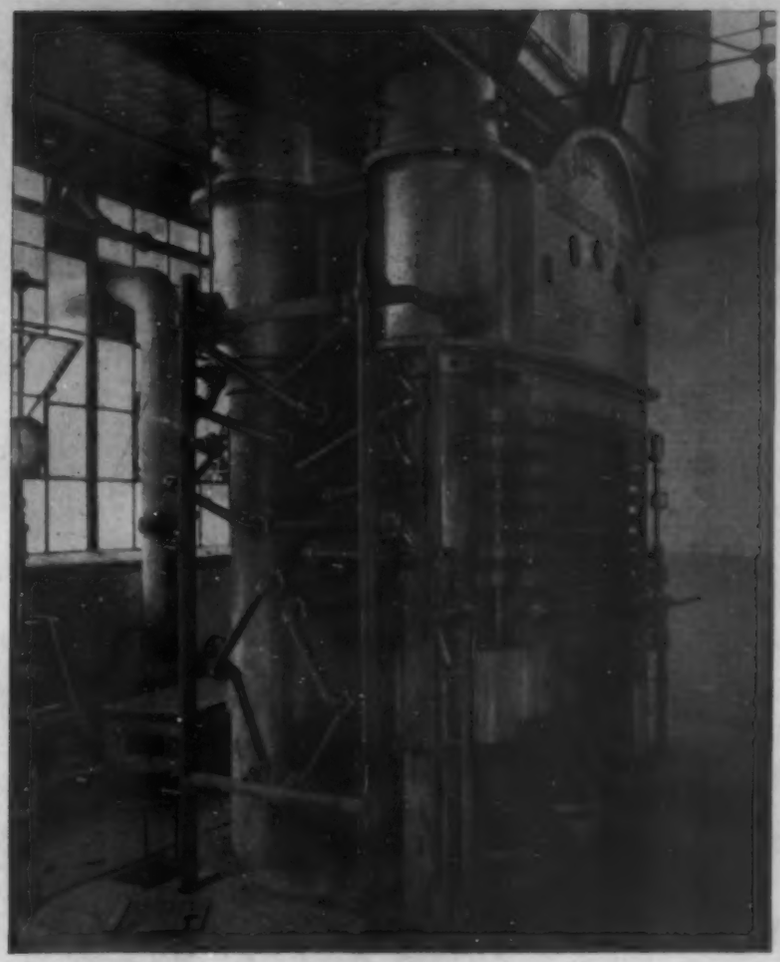


THIS IS YOUR FLEXIBLE JOINT SERVICE

For over 30 years . . . engineers, designers, draftsmen, and maintenance supervisors have specified and used Barco Flexible Joints in important services. They have incorporated Barco Flexible Joints in designs and services where flexible connections have been required to take care of movement or absorb vibration in the transmission of steam, air, oil, water, chemicals, and many other fluids and gases. Because of their ability to stand high pressures, high temperatures, and rough handling they have proved to be the most economical and satisfactory flexible conveyor obtainable. Our engineering department will give you the information necessary to work out your flexible joint problems. Write to: Barco Manufacturing Company, 1809 Winnemac, Chicago 40, Illinois.

BARCO

MANUFACTURING COMPANY, NOT INC.

DoALL BAND FILER

Cuts all the time
NO STOP —NO DRAG

SPEEDMASTER 1005 variable control fits file speed to work at any point between 80 and 280 feet per minute.

DoALL Band Filer, is a complete, self-contained unit—delivered ready for immediate service.

Band filing, like band sawing, is *continuous*—without stop and drag back. *All* of the action is *cutting* action, because the file teeth move only in cutting direction.

The resultant speed is amazing! Four times faster than reciprocal machine filing—nine times faster than hand filing! *Plus* smooth cut internal or external finishes, *file-broached* to tolerances beyond .001"—precision without experience, without fatigue.

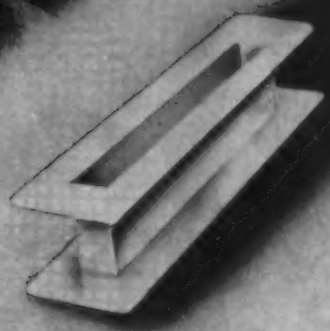
Investigate the tremendous advantages of DoALL Band Filing in production, tooling and maintenance work—on all metals, wood, fibre and plastics. There is a DoALL Sales Office near you—telephone now!

FREE: The services of the DoALL File Engineering Laboratory—bring or send your filing problem.

DoALL SALES OFFICES IN PRINCIPAL CITIES

DoALL BAND FILER Made by CONTINENTAL MACHINES, INC. Address Inquiries to 1301 S. Washington Ave., Minneapolis 4, Minn.

INDUSTRY'S NEW SET OF TOOLS SOLD AND SERVICED BY 34 DoALL OFFICES



TWICE SIZE

It can be done!

Coil forms with wall thickness of .009 and tolerances of ±.000 .001 are being INJECTION MOLDED by ARNOLD BRILHART LTD.

Material used: HM-119 LUCITE and FM-1 NYLON

Just another of the ... "Impossible things proven possible"

Send us your unusual problems in plastics!

ARNOLD Brilhart LTD.

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When It Comes To LONG RUNS..

You could always count on Gallagher & Shean for a top performance! . . . Remember? In fact, the longer their run the better their box-office!

Molds, too, when hard-chromium-plated, have a like quality —they never seem to wear out their capacity to produce—and long runs find them delivering perfect performance.

It is our suggestion that you check Industrial Hard Chromium's methods. We've a way with molds that make them good troupers . . . Positively? . . . Absolutely!

INDUSTRIAL HARD CHROMIUM CO.

"Armorplate for Industry"

15 ROME STREET • NEWARK, NEW JERSEY

DRAW UP A CHAIR AT THE PLASTICS FEAST

Like many another molder, we have contributed a variety of mechanical and ordnance parts of plastics to the waging of this war.

We have the additional satisfaction of knowing that we're also making life a little easier for our boys between actions.

The illustrated, unbreakable, boiling-water-resistant plastic dishes are just perfect for Navy men. Notice how the cup and saucer are molded to make a perfect fit.

This application of plastics has post-war possibilities which, no doubt, some smart manufacturer of picnic sets or breakfast crockery is already contemplating.

There are other overtones here for all industries. Plastics are basic materials which have many places and uses as yet unexplored. In pursuing the train of thought that might lead to their adoption in your production, we might be able to offer some assistance. We have a long and varied experience in molding plastics upon which you may feel free to draw for both wartime and post-war planning.

THE WATERTOWN MANUFACTURING CO.
Manufacturers - Molders - Plastic Products
WATERTOWN, CONNECTICUT

PRECISION MOLDING

The right combination of efficient designing and engineering assures you precision molding. Your exacting requirements are met promptly, efficiently and accurately, from small intricate designs to large 18 oz. moldings. Complete complementary equipment to answer your demand for plastic moldings, including complete dash panels, garnished moldings and similar trim.

ARMY E NAVY

The METAL SPECIALTY Co. PLASTIC DIVISION

MAIN OFFICE AND PLANT • ESTE AVENUE • CINCINNATI, OHIO

"Fine thing!.. now the kid sister does as much work as I do...

with

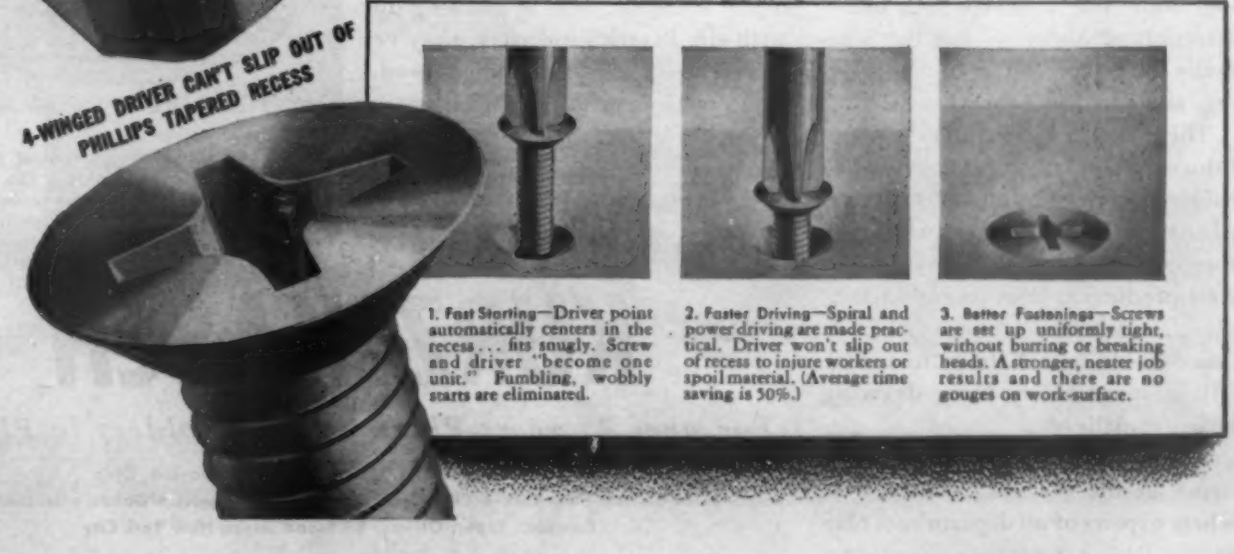
AMERICAN PHILLIPS SCREWS"

She... like thousands of other women... thought she had to be "big and strong" to hold down a job in a war plant. And for some jobs she would... like driving Slotted Head Screws. *But not for the job of driving American Phillips Screws,* because American Phillips Screw Driving is so easy... so free from strain on nerves and muscles... that her day's output on assembly work is right up there with her big brother's.

What could be simpler? All she does is aim the driver with one hand while the other hand holds the work. No wobbling at the start, no crooked driving, no time lost, no effort wasted.

This is why American Phillips Screw Driving is playing a major part in keeping production up in labor-short assembly departments that must employ women and inexperienced men.

AMERICAN SCREW COMPANY
PROVIDENCE, RHODE ISLAND
Chicago: 589 E. Illinois Street *Detroit:* 502 Stephenson Building



1. **Fast Starting**—Driver point automatically centers in the recess... fits snugly. Screw and driver "become one unit." Fumbling, wobbly starts are eliminated.

2. **Faster Driving**—Spiral and power driving are made practical. Driver won't slip out of recess to injure workers or spoil material. (Average time saving is 50%.)

3. **Better Fastenings**—Screws are set up uniformly tight, without burring or breaking heads. A stronger, neater job results and there are no gouges on work-surface.

IN SELECTING YOUR PLASTIC MOLDER — LOOK FOR BALANCE!

To do your molding job and do it right, your custom molder has four functions to perform—Engineering, Mold-making, Molding and Finishing. Some like to add a fifth one—Selection of Material—but that's actually an essential part of Engineering, and should be treated as such.

The measure of your molder's usefulness to you lies in his ability to so balance all these functions in one plant that soundly engineered, thoroughly inspected parts feed into your production lines on rigid schedules . . . without delays or excuses. In other words, on his ability to assume full responsibility from drawing board to delivery.

At Kurz-Kasch, this balance is struck at the Plastics Round Table, where experts of *all* departments plan production together with your engineers or designers. Behind them lies a generation of experience in molding all plastic materials by all accepted methods. And in growing up with the Plastics industry, they've picked up experience you might need. You can sit in with no obligation.

RIGHT NOW is the time for Design and Engineering on your post-war plastics applications. And, in some cases, Mold-making. Do this, and you'll have the jump on the field . . . we'll be all set to serve you better . . . and your Plans will turn into Products more smoothly. Ask for an engineer!

KURZ-KASCH

For over 25 years Planners and Molders in Plastics

Kurz-Kasch, Inc., 1417 South Broadway, Dayton, Ohio

Branch Sales Offices: New York • Chicago • Detroit • Los Angeles • Dallas • St. Louis • Toronto

Canada. Export Offices: 89 Broad Street, New York City

is planning your future

When this war is over, Industry—and particularly that field associated with chemicals and plastics—will face some difficult problems. The change-over to the production of consumer goods, in which plastics have become an important factor, is going to bring great expansion to that business. And the manufacturer who is ready to step into this "game" is going to get the business and make the profit.

In order to serve the Plastics Industry better, Watson-Stillman has enlarged its laboratory facilities. A new building houses complete equipment for conducting RESEARCH into any of the technical problems that will need solving before the Plastics Industry swings into peace-time production. Chemists and Mechanical Engineers are working together in this laboratory. Their combined efforts are directed at finding *better* plastic materials, and designing *better* machines to process them.

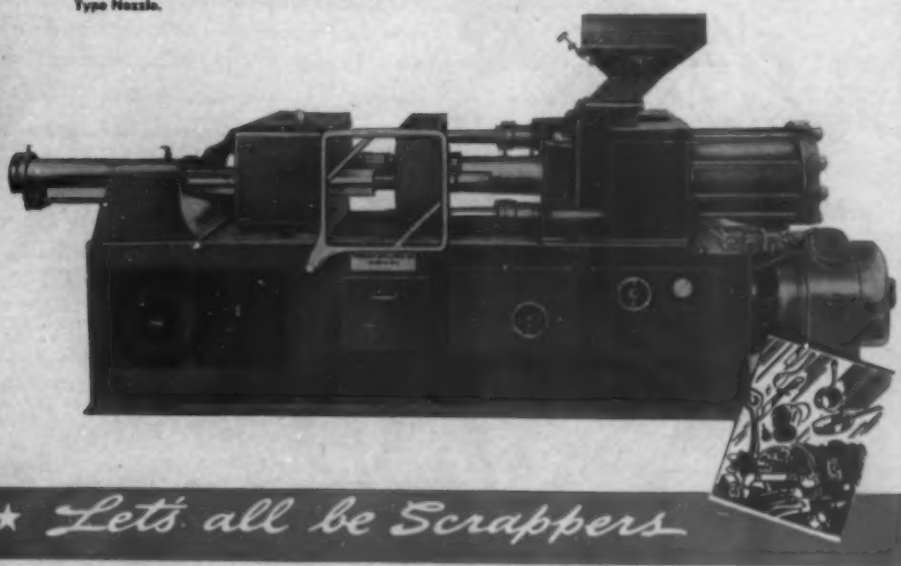
Watson-Stillman offers this service to the Plastics Industry as its contribution to post-war "recovery." Bring your problems to us NOW, and let us help you PLAN YOUR FUTURE. The Watson-Stillman Co., Roselle, N. J.

WATSON-STILLMAN

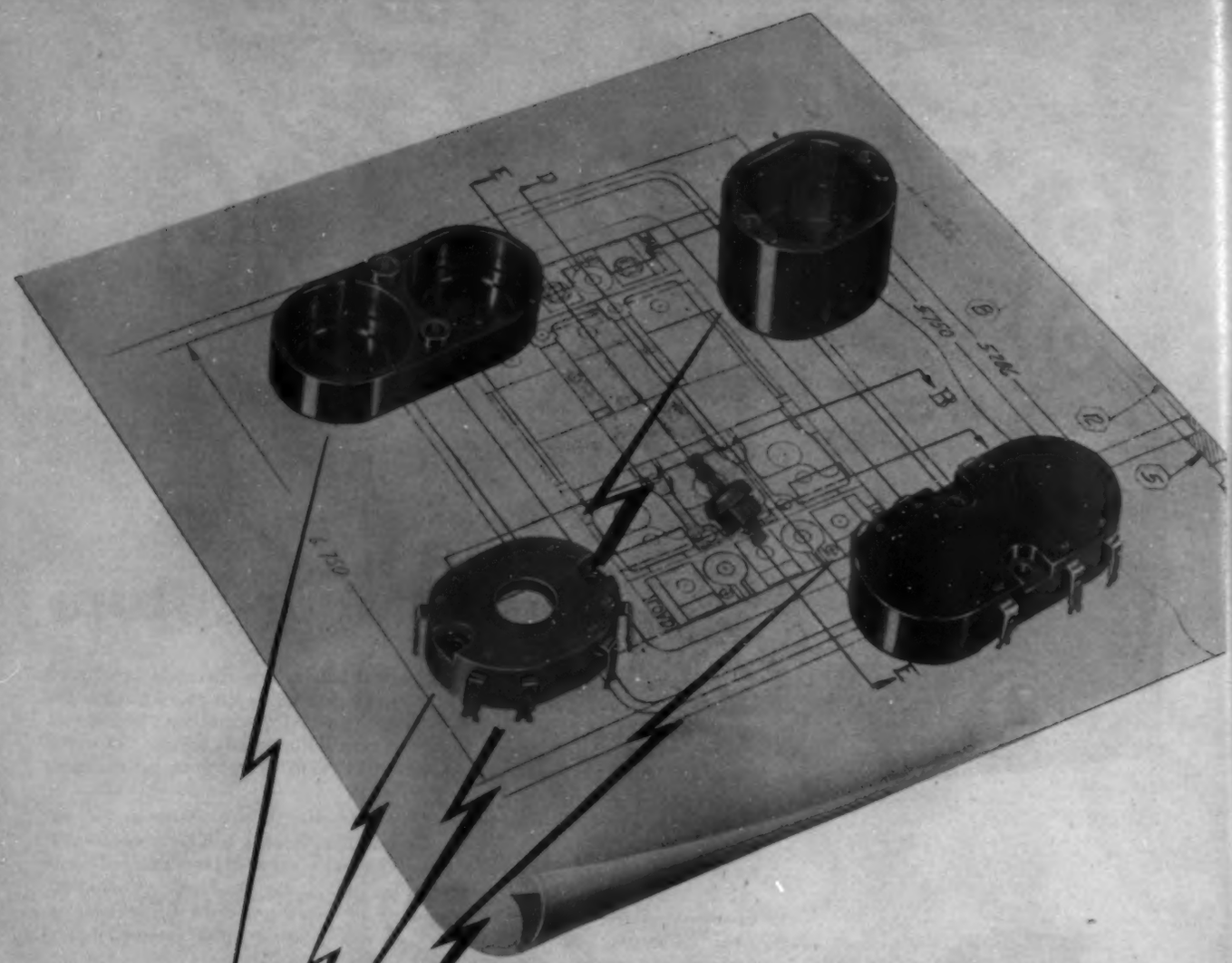
Hydraulic Equipment, Valves, Forged Steel Fittings

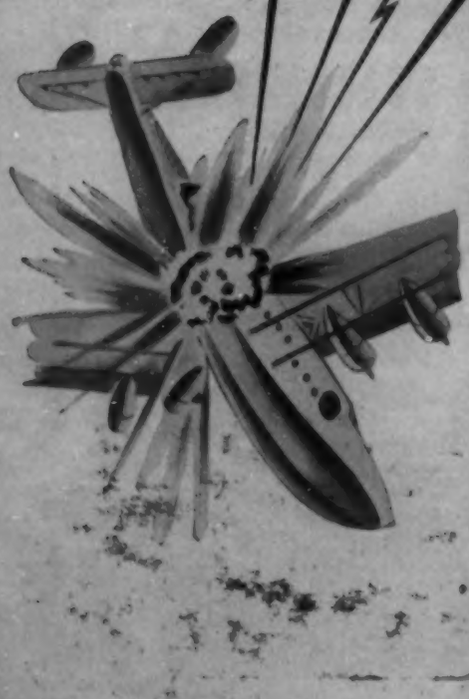
The automatic Compression Molding Machine is available in 25-ton, 50-ton and 75-ton types. Has centralized control, positive action, rapid mold changes.

This Injection Molding Machine is available in 6, 8, 12 and 16 oz. capacities. Equipped with Zoning Control Heating Cylinder, Positive Clamping Mechanism, Adapter-Type Nozzle.



For Victory ★★★ Let's all be Scrappers





PLASTIC BACKBONE

FOR THE ELECTRONIC GIANTS WHICH FIND AND DOWN THE ENEMY.....

The special properties of plastics are particularly suited to those amazing electronic devices used by our armed forces for detection, communication and fire control. Plastics, properly applied, combine structural and dielectric strength, low loss, resistance to heat and cold and other essential properties.

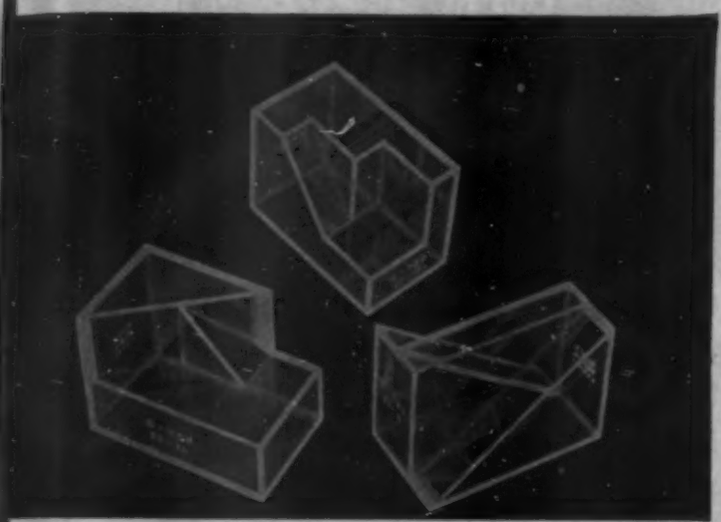
But it takes real engineering skill and production "know-how" to meet rigid delivery schedules with parts that measure up to strict specifications. Consider the plastic components pictured above. Molding tolerances are as close as those usually expected only in finely machined metals. The lugs and other metal inserts had to be molded integral with the plastic shell. Screw holes had to be accurately tapped. Proper "curing," of course, was essential to achieve exact electrical characteristics.

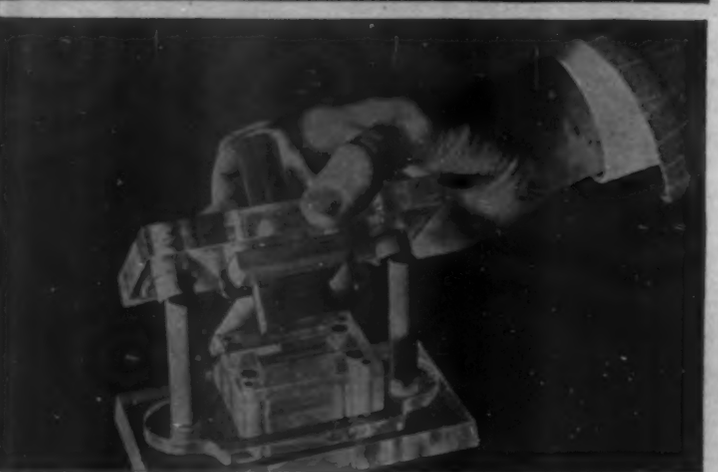
Such are the difficult assignments which we welcome here, at Molded Products, and which we are prepared to turn out all in one plant . . . *and on schedule.* Send us your specifications for quotations, or ask one of our engineers to consult with you. MOLDED PRODUCTS COMPANY, 4533 W. Harrison St., Chicago 24, Ill.

PLASTICS DIVISION

MOLDED PRODUCTS

How Plexiglas models are clarifying war training problems





Top to bottom: PLEXIGLAS models for mechanical drawing courses; transparent specimen showing internal details; die stamp model disassembled to show construction.

TRANSPARENT models of PLEXIGLAS give mechanical drawing students in war-accelerated training courses a new grasp of the subject...making angles and planes of intricate figures completely visible in any projection from any plane. The interior details of mechanisms are clearly revealed. The fundamentals involved in the design of dies, jigs, and other tools are more readily comprehended with the aid of PLEXIGLAS models.

Test models of new engineering designs and display models for all purposes are other applications where the exceptional transparency, ease of fabrication, strength, and rigidity of PLEXIGLAS offer unusual advantages.

Isn't there a place in your own present production or post-war plans where this combination of features can be used to advantage? If you want to know more about the ways in which you can benefit by using this crystal-clear plastic, call the nearest Rohm & Haas office—Philadelphia, Los Angeles, Detroit, Chicago, Cleveland, New York.

***Only Rohm & Haas makes* PLEXIGLAS**

3 awards to Rohm & Haas Company and its associated firms, The Resinous Products & Chemical Company and Charles Lennig & Company.

PLEXIGLAS

CRYSTAL-CLEAR ACRYLIC SHEETS, RODS AND MOLDING POWDERS*

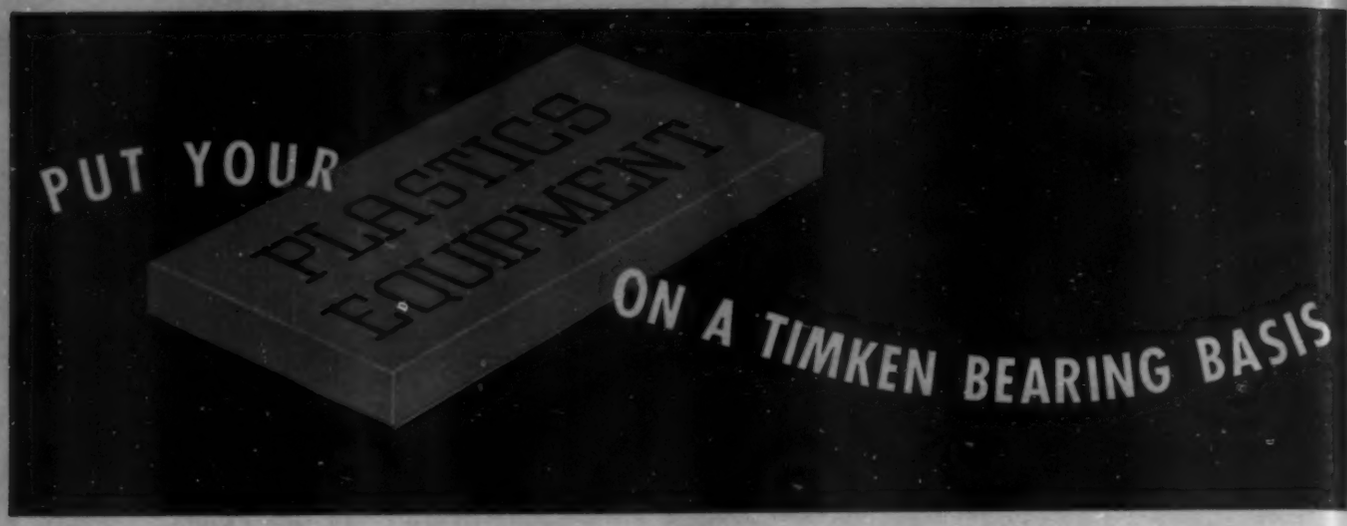
*Formerly CRYSTALITE Molding Powders

PLEXIGLAS is the trade-mark, Reg. U. S. Pat. Off., for the acrylic resin thermoplastic sheets, rods and molding powders manufactured by Rohm & Haas Company.

ROHM & HAAS COMPANY

WASHINGTON SQUARE, PHILADELPHIA 5, PA.

Manufacturers of Chemicals including Plastics . Synthetic Insecticides . Fungicides . Enzymes . Chemicals for the Leather, Textile and other Industries

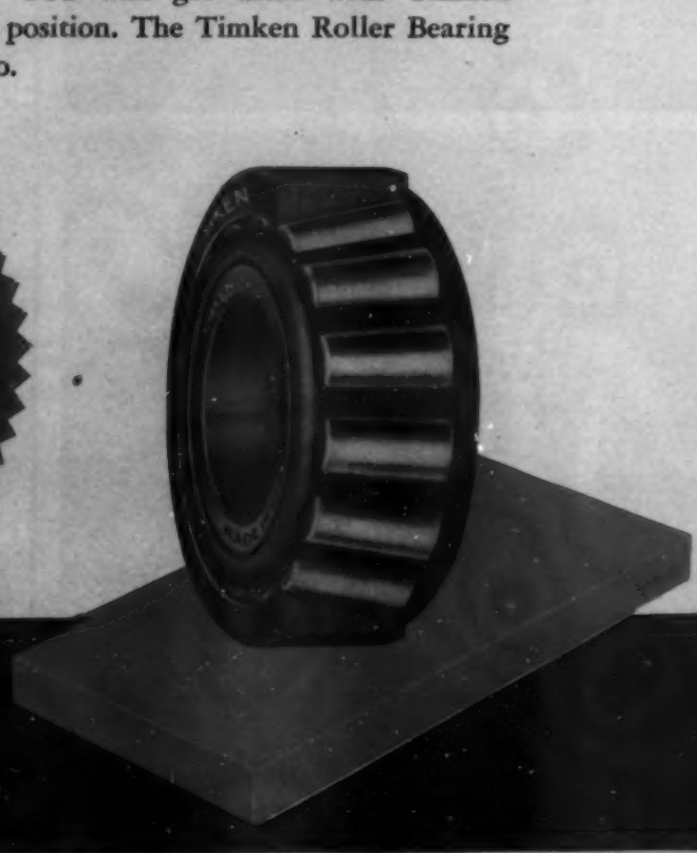


There is no bearing problem in plastics production that Timken Bearings cannot solve—this comprises primary and auxiliary equipment of every kind and includes every position for which Timken Bearings are suitable.

Breaking into new industries is an old story to Timken Bearings. They've been doing it with outstanding success for more than three decades—meeting and beating every operating condition they've ever been matched against.

They step up speed; promote precision; increase endurance; extend machine life; save power; simplify lubrication; and cut maintenance expense. You need all of these advantages in your plastics equipment. You will get them with Timken Bearings at every suitable position. The Timken Roller Bearing Company, Canton 6, Ohio.

To Plastics Equipment Manufacturers: Get a start on post-war competition by redesigning your machines now and using more Timken Bearings.



TIMKEN
TAPERED ROLLER BEARINGS

MAINE STEEL, INC. *Reports . . .*

"Greatest Time and Money Saver in Die-sinking Machinery in 25 Years!"

"You may remember that about a year ago you sold us a Rotary Head Die-Sinking Machine. We feel that it is time that we told you what we think of it.

The Rotary Head principle has saved us more time and money than any other improvement in Die-Sinking Machinery since Cherrying Attachments were invented more than twenty-five (25) years ago.

The principal reason is that we can sink four (4) impressions complete without moving the work on the table.

This saves three (3) setups out of four (4) when compared to a Rotary Table Machine.

This saving would of course be increased where more than four (4) impressions are needed.

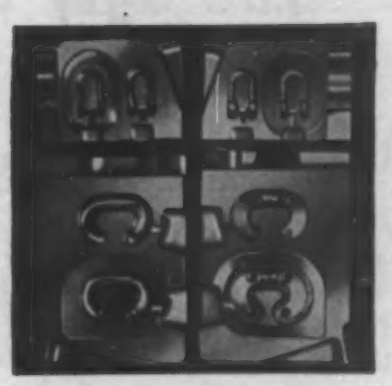
Besides this — the various movements built into this Rotary Head enable us to sink our dies without first laying them out on the Die Blocks.

The machine does its own layout work.

And after a year's experience we can say that these two features have averaged to save us over 30% of our die-sinking time.

Yours very truly,

MAINE STEEL, INC.
A. A. Rines
Foreman—Die Sinking Dept. "



This is typical of the forging dies produced by Maine Steel, Inc. The Milwaukee Rotary Head Miller has saved this firm over 30% in die-sinking time on dies of this type.

Kearney & Trecker's Rotary Head Miller is regarded by the majority of users as the most versatile machine ever designed for die and mold work. Direct — fast — accurate — it reduces initial job preparation and set-up time to the minimum — saves operator's time and assures rapid production of dies and molds. Write for Bulletin No. 1002C for full information on this unusual machine tool.

Rotary Head Milling Machine
•
Autometric Jig Borers
•
Center Scope

Kearney & Trecker
Products
CORPORATION
Milwaukee, Wisconsin
Subsidiary of Kearney & Trecker Corporation

Milwaukee Face Mill Grinder
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Milwaukee Midgetmill
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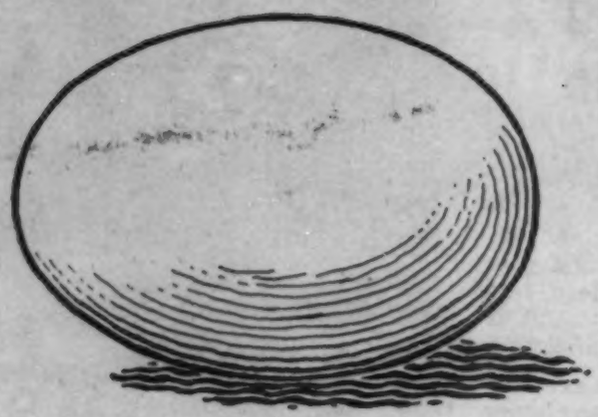
Milwaukee Speedmill



The ugly duckling that didn't hatch!

YOU don't want any "ugly ducklings" when you hatch out a platen press load for a rush order. *And you won't get any* with Taylor Flex-O-Timers on the job, because they make the whole operation so accurate that ONE PRESS LOAD IS EXACTLY LIKE ANOTHER!

All the operator has to do is *load the press and push the button!* The press closes automatically and the steam valve opens to admit steam into the platens. At the end of the molding period, the steam is automatically shut off and water turned on for automatically timed cooling. And after the predetermined cooling period, the water is shut off and the press opens automatically for unloading! If the product requires "gassing" or "bumping", this function can be performed automatically also.

In fact there's only one thing the Flex-O-Timer doesn't do—maintain the required platen temperature. But you can handle that with a Taylor Fulscope Controller! Ask your Taylor Field Engineer for the full story! Taylor Instrument Companies, Rochester, N. Y., and Toronto, Canada. *Instruments for indicating, recording, and controlling temperature, pressure, humidity, flow and liquid level.*

ARMY NAVY

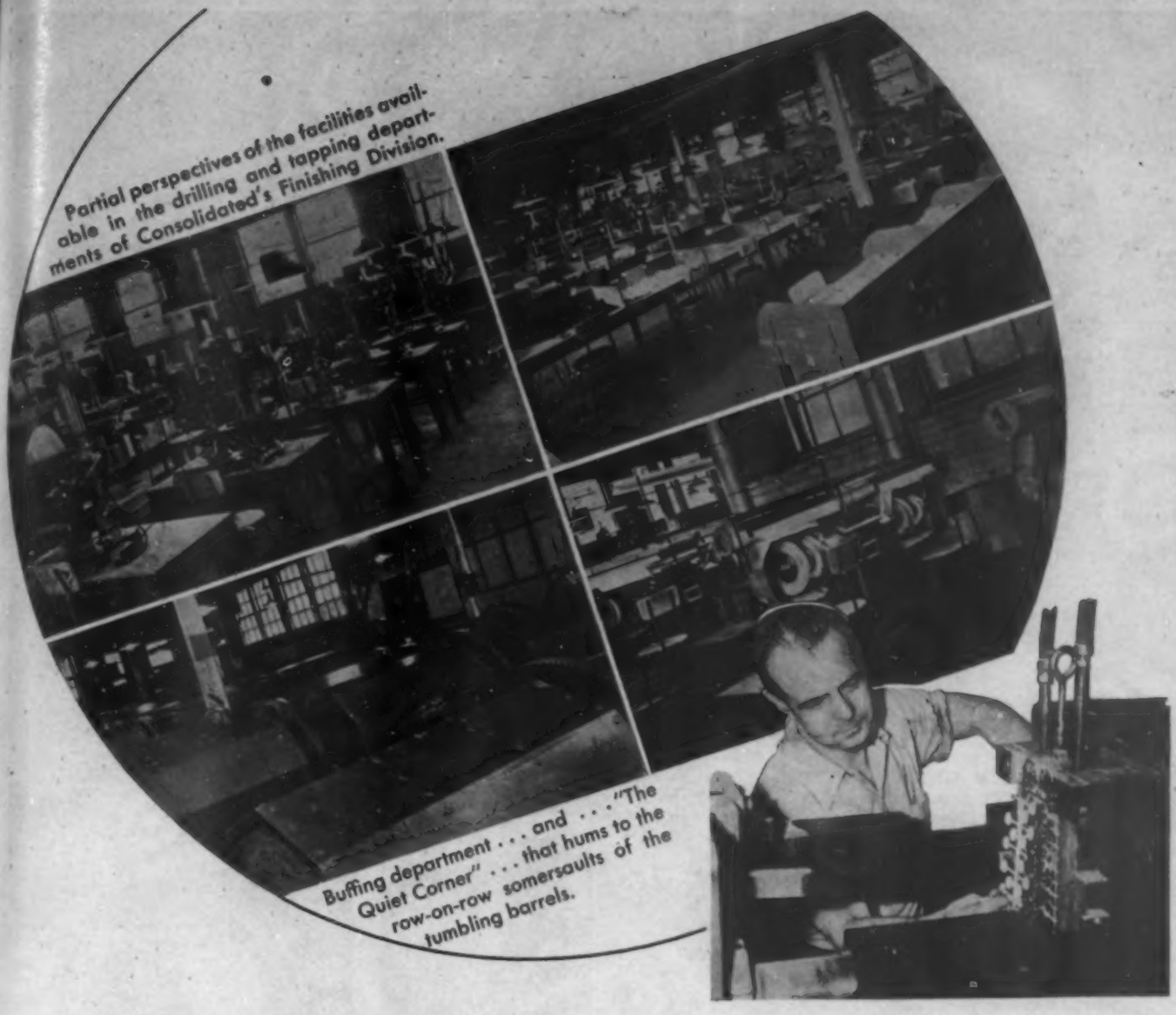
Taylor Instruments

MEAN

ACCURACY FIRST

IN HOME AND INDUSTRY

★ KEEP ON BUYING U. S. WAR BONDS AND STAMPS ★



Partial perspectives of the facilities available in the drilling and tapping departments of Consolidated's Finishing Division.

Buffing department . . . and . . . "The Quiet Corner" . . . that hums to the row-on-row somersaults of the tumbling barrels.

Facilities to Finish Anything We Start!

Consolidated's finishing divisions are equipped with multiple compartment tumbling barrels, button drilling presses, bench type drilling presses, buffers, sanders, automatic bench machines, arbor presses, bench band saws, spray booths, spray guns and other facilities which, if listed in their sum total, would impress you with the completeness of Consolidated's auxiliary equipment . . . these are all essentials to good molding service.

Consolidated

Molded Products *Corporation*

309 CHERRY STREET • SCRANTON 2, PA.

NEW YORK
1790 Broadway

BRIDGEPORT
Rocky Ridge Drive

CHICAGO
549 West Randolph St

DETROIT
2970 West Grand Blvd

CLEVELAND
3682 Ingleside Road
(Shaker Heights)

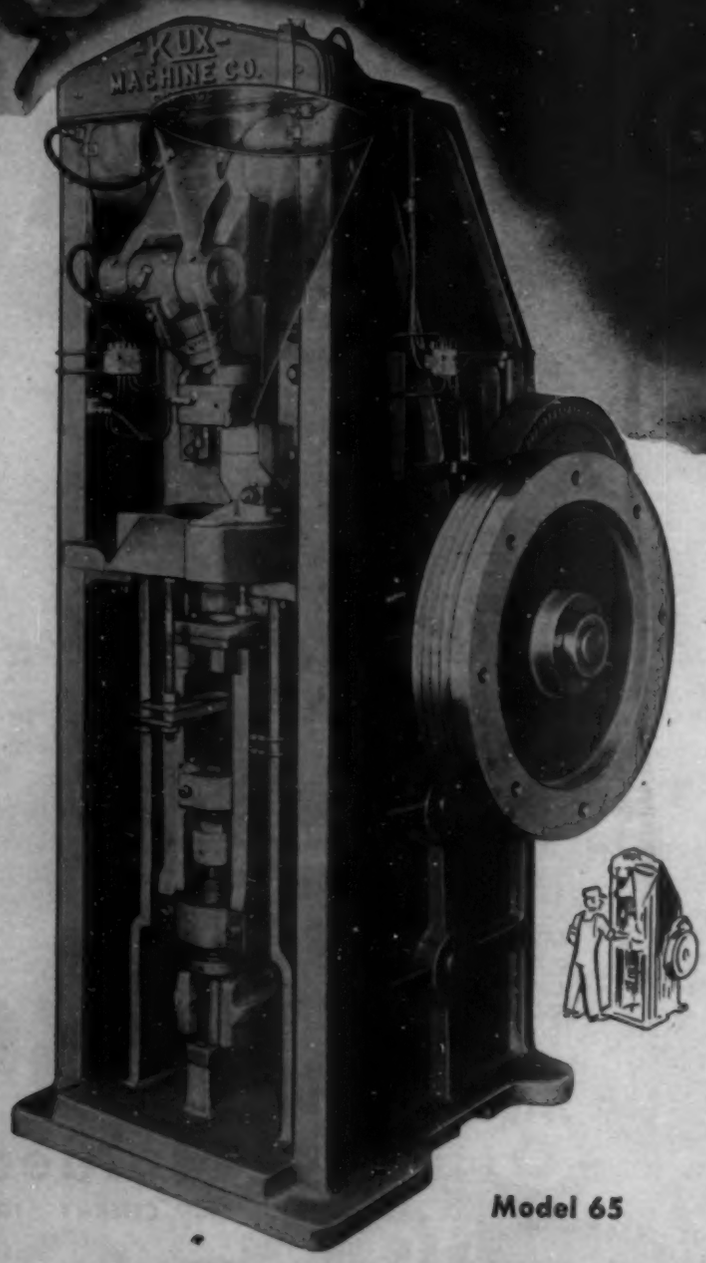
PLENTY RUGGED

Kux Preform Presses

THE NEW MASSIVE MODEL 65 PRODUCES PREFORMS 3" DIAMETER, HAS A 3" DIE FILL AND APPLIES 75 TONS PRESSURE

This rugged preform press with its heavy duty, one-piece cast steel main frame will produce odd shapes as well as round preforms. The pressure applied by both top and bottom punches results in more solid, dense preforms, which have less tendency to crumble or break during handling. This new Model 65 press is built to safely withstand high pressures of up to 75 tons at top production efficiency.

Choice of a complete size range of machines in both single punch models and multiple punch rotaries is also available.

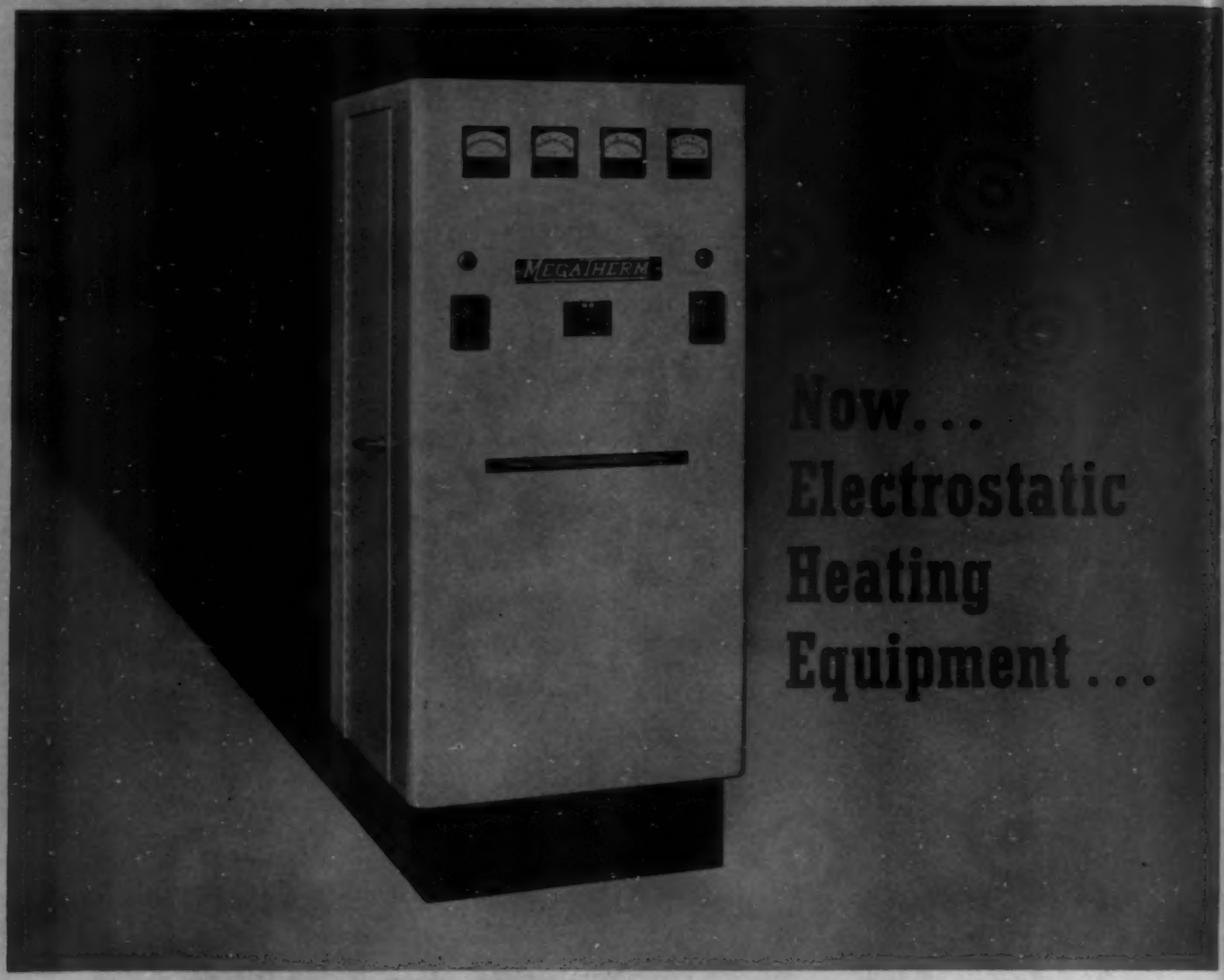


Model 65

KUX MACHINE COMPANY
3924-44 W. Harrison St., Chicago

● Write Dept. P for catalog or demonstration

INJECTION
Molding
Between the proposed sketch – and the injection-processed piece or part, stands Mold preparation. This all-important facility, as Sterling practices it, is customer-headache-free. Our die-making divisions are staffed by highly skilled hands – served by the finest tooling-up equipment – and directed by principals with years of plastics experience and engineering know-how. When Sterling-made molds take up their press position . . . sterling production results!
STERLING PLASTICS CO.
1140 COMMERCE AVE.
UNION, NEW JERSEY



Now... Electrostatic Heating Equipment...

...Designed and Built to the Special Requirements of the Plastics Industry

RUGGED
Stands Hard Usage; ⅛" Steel Cabinet

RELIABLE
Gives Efficient, Dependable Service

PORTABLE
Easily Moved for Any Application

COMPACT
All-in-one Unit Saves Floor Space

SIMPLE
Strictly Non-technical in Operation

SPEEDY
Increases Production

ECONOMICAL
Reduces Heating Time and Die Costs

SAFE
Complete Protection for Operator

In pioneering megacycle radio energy for industrial use, Federal has developed an application for Plastics processing that is unique both in conception and performance.

Through its Megatherm equipment it has put radio frequency heating on a practical basis, which assures perfect molding at low pressures, prevents breakage of die inserts, reduces curing time from minutes to seconds and provides uniformity, speed and economy.

Constructed along the same lines as any other machine tool, Megatherm equipment is installed without change in plant layout. It is ready for operation — merely has to be set alongside press and started to work for double or triple production. Simplicity of the unit eliminates tuning or other adjustment. It is controlled by two push buttons, with foot switch optional, and can be operated by unskilled, untrained help.

Megatherm will give you greater production at less cost.

We shall be glad to discuss it with you in terms of your requirements.

-MEGATHERM-

Federal Telephone and Radio Corporation

INDUSTRIAL ELECTRONICS PRODUCT DIVISION, Newark, New Jersey

AN IT&T ASSOCIATE

A PROPHECY FOR PLASTICS

PLASTICS will keep the world moving faster in the New Age beyond the War. That is a definite prophecy, based on developments now taking place in the plastic fabrication for industries related to war production as well as for domestic manufacture. In fact, Plastics loom as one, if not the greatest of the Industrial Post War Giants. The Rodgers Hydraulic Plastic Press, available again when peace comes, is an acknowledged leader in this field of tremendous potentialities. ★ ***If it's a Rodgers, it's the best in Hydraulics.*** ★ Rodgers Hydraulic, Inc., St. Louis Park, Minneapolis, Minn.

Manufacturers of:

HYDRAULIC PLASTIC PRESSES
UNIVERSAL HYDRAULIC PRESSES
HYDRAULIC KEEL BENDERS
POWER TRACK WRENCHES
HYDRAULIC TRACK PRESSES
HYDROSTATIC TEST UNITS
HYDRAULIC REPAIR EQUIPMENT FOR THE OIL FIELD

Rodgers HYDRAULIC Inc.

Boost War Production

with your present labor force . . . by using DELTA POWER-FEED DRILL PRESSES

Delta Features

1. Worm-driven power feed operates directly off motor — giving 8 *rates of feed for each spindle speed.*
2. One swift hand motion brings drill down to work — flip of power lever starts power feed.
3. Automatic stop holds depth of holes to close tolerances; spindle returns automatically.
4. *Instant* switching from heavy power-feed operations to sensitive hand drilling.

It doesn't cost a fortune or entail a long delay for retooling, to install Delta Power-Feed Drill Presses. Standard low-cost Deltas, used in hundreds of war plants, give quick relief from production "jams." Speedy operation saves time, power feed works automatically while operator loads another jig or works on another spindle — adding to output, cutting costs.

These are thoroughly engineered, substantially built, good-looking machines, made in a modern machine-tool plant devoted entirely to tooling war industries. Advanced design combines best features of machines of this type. Safe, dependable, performance under the punishment of war production, quickly pays for the machines and confirms your good judgment in installing them.

Your Delta distributor can show you ample evidence in your vicinity. Consult him — ask about priorities and deliveries. Mail the coupon for new Delta catalog.

M-3

Floor type 4-spindle model at left. Other models with one-piece tables: Floor and bench types, single spindle; floor type, 2-spindle. Floor types with sectional tables: 3-, 4-, 5-, 6-, and 8-spindle. All models available with Slo-Speed or High-Speed No. 2 Morse Taper or ½" Jacobs Chuck spindle.

DELTA MILWAUKEE Machine Tools

Tear out this coupon, mail today

THE ARMY-NAVY "E" — *awarded for excellence in the production of machine tools vitally needed in the war effort.*

THE DELTA MANUFACTURING COMPANY
520K E. Vienna Ave., Milwaukee 1, Wis.

Please send me your new catalog giving full details on the Delta Power-Feed Drill Presses and your full line of low-cost machine tools.

Name..... Position.....

Company.....

Address.....

City..... (.....) State.....

LEA COMPOUND Eliminates Hand Filing

*Reports American Insulator Corporation**

Molding an idler crank in rag-filled Bakelite left a heavy flash at the parting lines—and dumped a stiff production problem right in the lap of American Insulator Corporation, New Freedom, Penna.

Formerly, each part was hand-filed to remove flash and the resulting seam was buffed. It was a slow process, so they searched for and found a better and a faster way.

> *"The laborious process was eliminated by the use of a LEA COMPOUND operation. LEA COMPOUND is used on a soft cloth buff 7" in diameter, running at a speed of 2350 R.P.M. This change to LEA COMPOUND has permitted a definite SAVING in COST and TIME, and PRODUCES A BETTER FINISHED APPEARANCE than was possible by the hand-filing method."*

To meet other war production needs, LEA engineers have developed many new techniques. For example, by the use of various types of cone-shaped bobs, operating on a tapered spindle, counter-sunk holes of varying diameters can be burred effectively without filling threads or holes with foreign material.

Write LEA in detail about your burring, polishing, or buffing problem. Invite a LEA engineer to call for a consultation. He will gladly help you solve your problem.

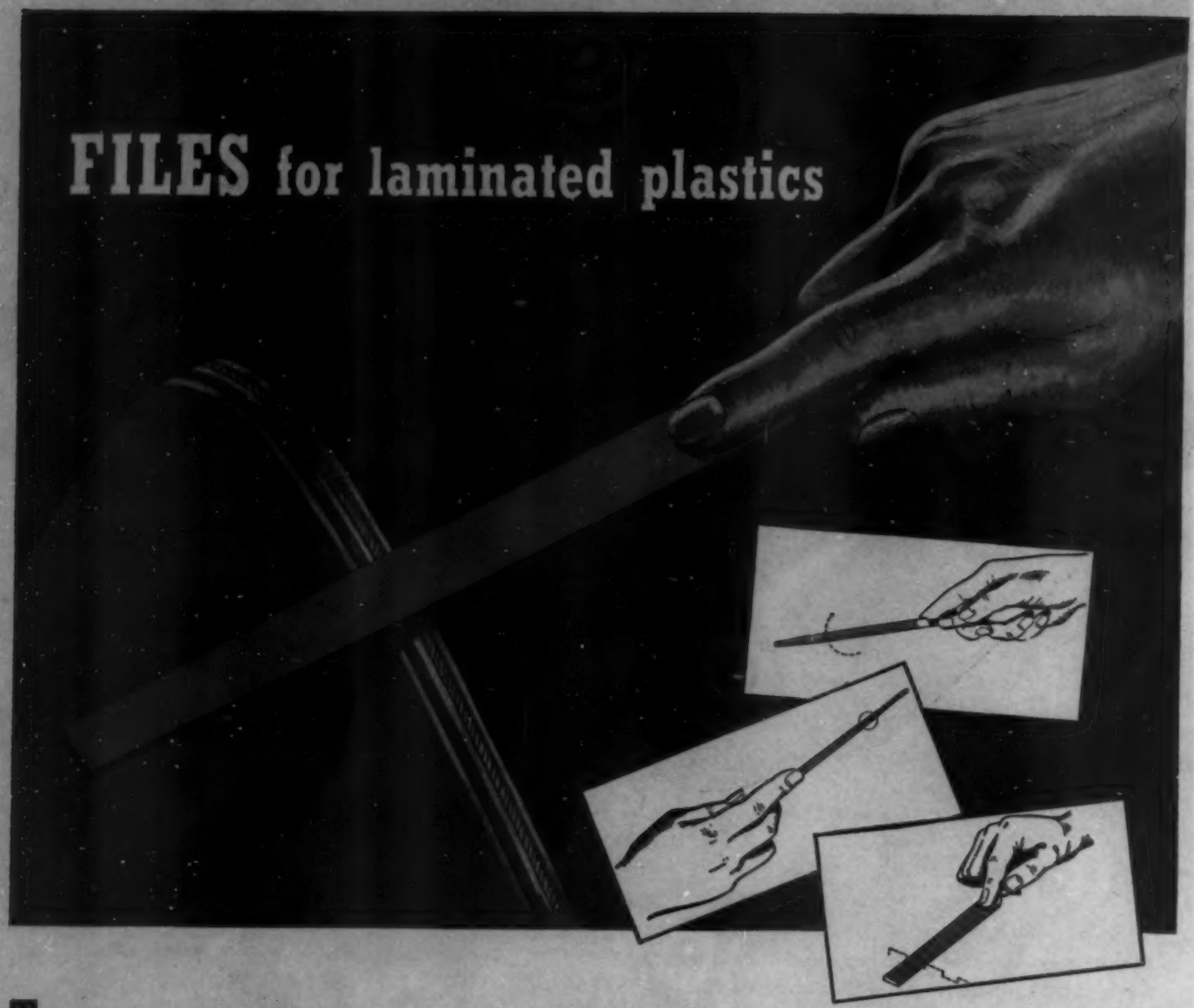
*Photographs and data courtesy American Insulator Corporation

THE LEA MFG. COMPANY

Waterbury 86, Connecticut

Burring, Buffing and Polishing . . . Specialists in the Development of Production Methods and Compositions.

FILES for laminated plastics



THE tremendous advancements being made in thermoplastic-bonded laminations of paper, wood and plywood present finishing and fitting problems quite distinctive from those involved in solid-molded plastic products.

Edges and corners of sawed sheets—notches and drilled holes—die-formed bevels and edge-beads . . . all call for smoothing operations which must contend with the danger of springing, separating or "fuzzing" the laminations. They must deal simultaneously with both fibrous and plastic materials.

Since filing is usually the best method—especially in narrow quarters and on irregular contours—selecting *The right file for the job* is important.

The Nicholson Mill Bastard and Western Cut have probably the widest efficient ranges for square, beveled and beaded edges. Nicholson Flat and Half Round Files in the required cuts serve excellently on fitting work; and Nicholson Round Files, of assorted thicknesses, for cleaning out holes and rounded slots.

In all cases, the direction of filing should be "against," not "off," the edge to make certain the laminations are held together.

• • •

Nicholson has made an extensive study of plastics filing. Wide gullets, to minimize clogging; and thin-topped teeth, to combat the abrasive action of certain thermoplastics and to maintain sharp cutting edges longer—are some of the engineering considerations given to Nicholson and Black Diamond Files for plastics in general. These quality files include various regular types, and also several types of X.F. Swiss Pattern, including Knife, Pillar and Button.

When seeking files for your purposes, you can be sure they are correct when Nicholson-endorsed "For Plastics." Consult your mill-supply house—or present your problems direct to us for the recommendations of our engineers.

FREE BOOK, "FILE FILOSOPHY," *on kinds, use and care of files—48 interesting illustrated pages.*

NICHOLSON FILE COMPANY • 44 ACORN STREET • PROVIDENCE 1, R. I., U. S. A.

(Also Canadian Plant, Port Hope, Ontario)

NICHOLSON FILES FOR EVERY PURPOSE NICHOLSON U.S.A.

PROBLEM:
Adding Machine Housing
Must be large, hollow plastic form, having dimensional stability, great inherent strength, dielectric properties, ability to take engraving and a permanent, attractive finish. Must not become brittle or crack under temperature changes and constant jarring.
SOLUTION: KYS-ITE
The long fibred pulp and synthetic resin plastic preformed before curing.

The adding machine above is only one of many prewar products made from Kys-ite, remarkable thermo-setting plastic. Its impact strength, 4 to 5 times greater than ordinary plastics, is not lessened by permanently incorporating metal inserts and support points into the forms. Most machining operations necessary in finishing metal castings are eliminated, saving time, material and expense. Interior insulation for quiet operation is unnecessary; Kys-ite is non-reverberating.

We've made trays, typewriters, radios, batteries, window frames and machine parts from this fibrous plastic material, before concentrating entirely on high priority war work. Kys-ite's abrasion resistance, durability, impact and dielectric strength, lustrous finish, wide range of colors and light weight make it unique among plastic materials.

KEYES
MOLDED PRODUCTS

In our many years' experience with molded pulp, KYS-ITE is perhaps the most unusual material we have ever developed. If its characteristics suggest applications to your products we will be glad to help you plan ahead. A letter from you starts our engineers working on your post-war problems.

BUY WAR BONDS *NOW!*

They keep coming to
"HEADQUARTERS" for
HOBBED CAVITIES

Hob and cavity comprising a very recent job performed by Midland. Hob measures 4 inches long, 3 inches wide, 2 inches deep. Sinking was made in a block 10 inches by 8½ inches by 5 inches.

Hobbed Cavities by Midland...

Do a difficult job well, and you invite more of the same. Hobbing deep and intricate cavities is not easy, as many molders and die makers have found. Our success in this branch of mold making is bringing more and more of this type of work to us. Equipment, experience and location are all advantages in having your mold and die work done at Midland.

D&E

MIDLAND DIE AND ENGRAVING COMPANY

1800 W. BERENICE AVENUE . . . CHICAGO 13, ILLINOIS

Makers of Plastic Molds • Die Cast Molds • Engraved Dies • Steel Stamps • Hobbings • Pantograph Engraving

HEARING with PLASTICS

Out of stillness, into the world of sound—through plastics! Here is a modern miracle, aid to the hard-of-hearing at a revolutionary low price, another example of the unlimited potentialities of advanced skill in thermoplastics. This was another test of the ingenuity, versatility and craftsmanship for our organization—and it has been passed with flying colors. We shall be glad to assist you with your plastics problems of today and your plans for tomorrow's post-war period.

Write on your letterhead for the Injection Molded and Extruded Plastics Catalog III. Also available is a new six-page circular on MILLS-PLASTIC tubing and fittings. *Made of Saran.*

Housing and four ear pieces molded for Zenith Radio Corp., Hearing Aid Division, Chicago, Illinois.

ELMER E. MILLS CORPORATION

Molders of Tenite, Lumarith, Plastacele, Fibestos, Lucite, Crystallite Polystyrene, Styron, Lustron, Loalin, Vinylite, Mills-Plastic, Saran and Other Thermoplastic Materials

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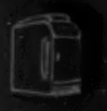


Plastic Molding by **REYNOLDS**
Means Far More than Just Buildings Machinery, Labor and Material

Plastic Molding at REYNOLDS means resourcefulness . . . intelligent ingenuity . . . skilled engineers . . . experienced workmen . . . and the determination to protect the interests of REYNOLDS' customers.

Here you will find the ability to give you what you want when you want it . . . and a deep appreciation of the problems of the other fellow.

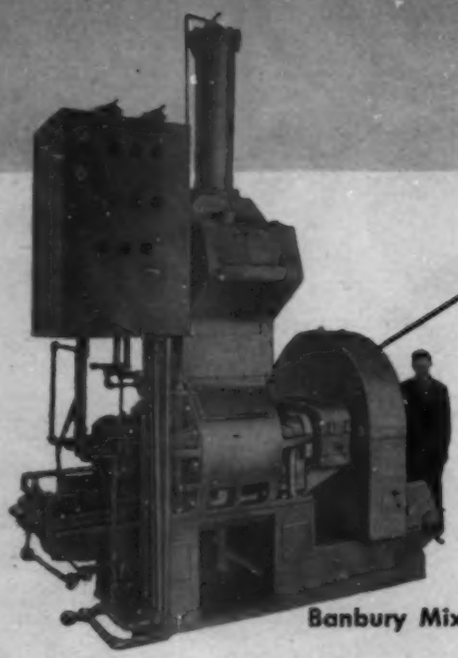
Your inquiries are solicited on the basis of this policy. Our Engineers will gladly study your plastic problems, whether for compression, injection, extrusion molding or sheet forming.

REYNOLDS MOLDED PLASTICS

CAMBRIDGE OHIO U. S. A.

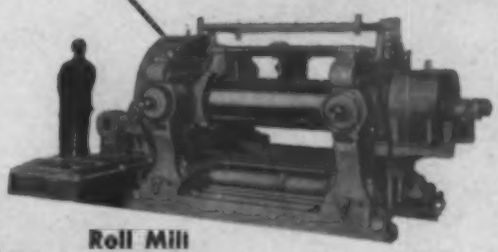
DIVISION REYNOLDS SPRING COMPANY • JACKSON MICHIGAN U. S. A.

MODERN PLASTICS MACHINERY



Banbury Mixer

Sheeting Calender



Roll Mill

Gordon Plasticator

Farrel-Birmingham processing machines have kept pace with the many rapid changes in the plastics industry. When recent developments called for heavier milling equipment for converting and mixing at higher temperatures, new designs were immediately made available. Whether you need a Banbury, roll mill, plasticator, or calender, for laboratory or production use, you can be sure the Farrel-Birmingham machine you specify will be modern in every respect.

The Banbury is suited to many applications in the plastics field, producing mixes of exceptional uniformity and superior quality, with large savings in power, labor and other costs.

Roll Mills are specially designed for processing plastics. For stocks which are sensitive to contamination, the rolls can be plated and other parts which come in contact with the stock made of corrosion-resistant metals.

Calenders for sheeting plastic materials are built to fit individual requirements. They are made with any number and arrangement of rolls, and fitted with attachments to suit their particular function.

Gordon Plasticators are used for continuous mixing of the powders or granules which go into numerous thermoplastics. By proper grinding and mixing and the application of heat at the right stage, the ingredients are blended and fused into a homogeneous whole.

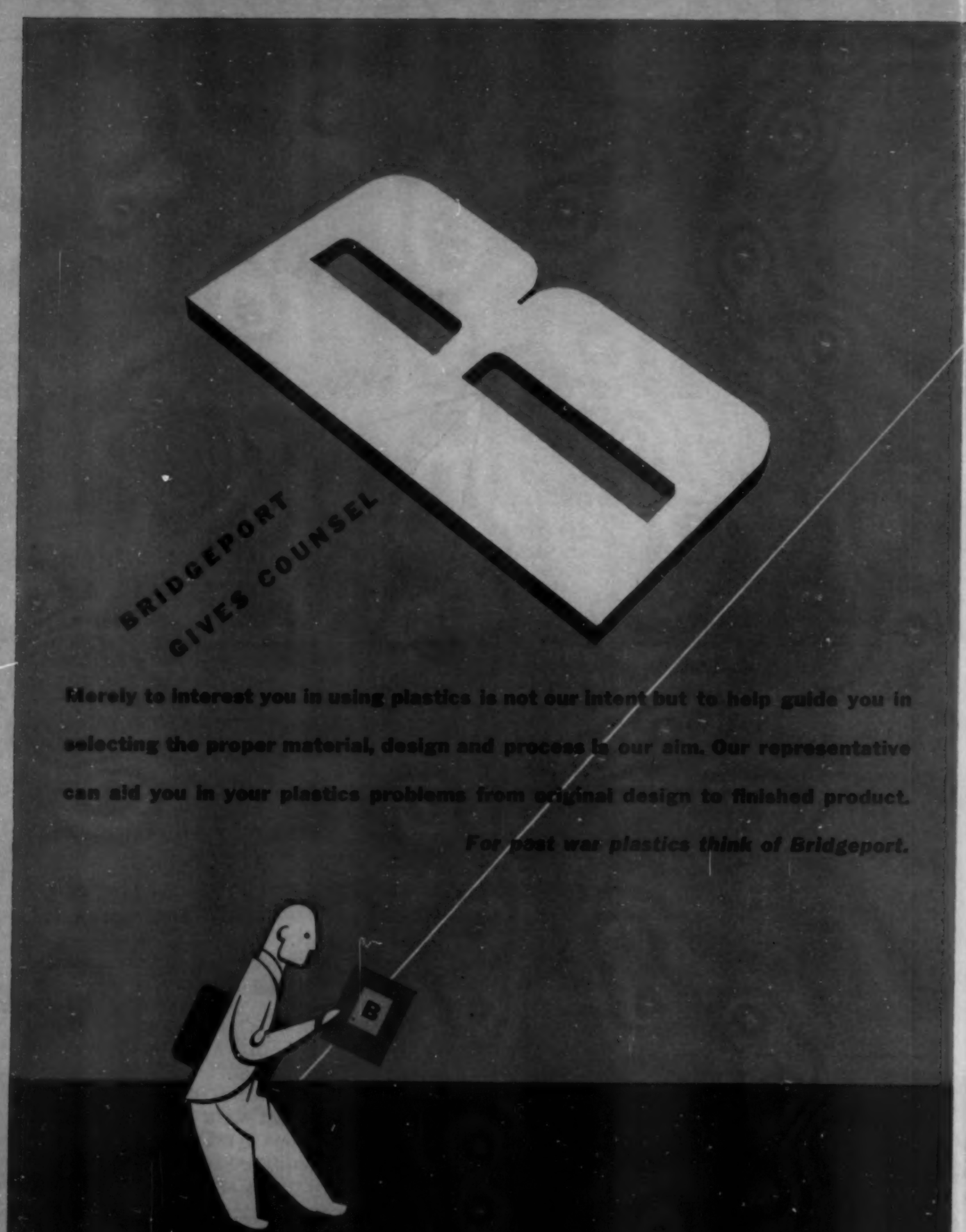
Write for further information regarding any of the equipment mentioned on this page.

F-B PLASTICS MACHINERY

HYDRAULIC ACCUMULATORS
BANBURY INTERNAL MIXERS
CALENDERS
EXTRUDING MACHINES
ROLL MILLS
HYDRAULIC PRESSES
CONVERTING, MIXING AND SHEETING ROLLS
SHEET CUTTERS OR PLANERS

Farrel-Birmingham

FARREL-BIRMINGHAM COMPANY, INC., ANSONIA, CONN.
Plants at Ansonia and Derby, Conn., Buffalo, N. Y.


B
BRIDGEPORT
GIVES COUNSEL
Merely to interest you in using plastics is not our intent but to help guide you in selecting the proper material, design and process is our aim. Our representative can aid you in your plastics problems from original design to finished product.
For post war plastics think of Bridgeport.
B
BRIDGEPORT MOULDED PRODUCTS, INCORPORATED
BRIDGEPORT, CONNECTICUT

Does the *paper* embodied in your product or packaging get the same degree of analytical engineering that you give to other component parts of that product? . . . or are you merely attempting to adapt some "ready made" paper that has "approximately" the properties you think are needed?

Do you call in a qualified paper specialist who is thoroughly informed on all the potentials of paper . . . who can engineer and create special papers to do the job you want paper to do on your processing machines? Or is there a "vacant chair" at your product planning conferences, in which a Mosinee paper technician could function and create the paper best suited for your specific needs?

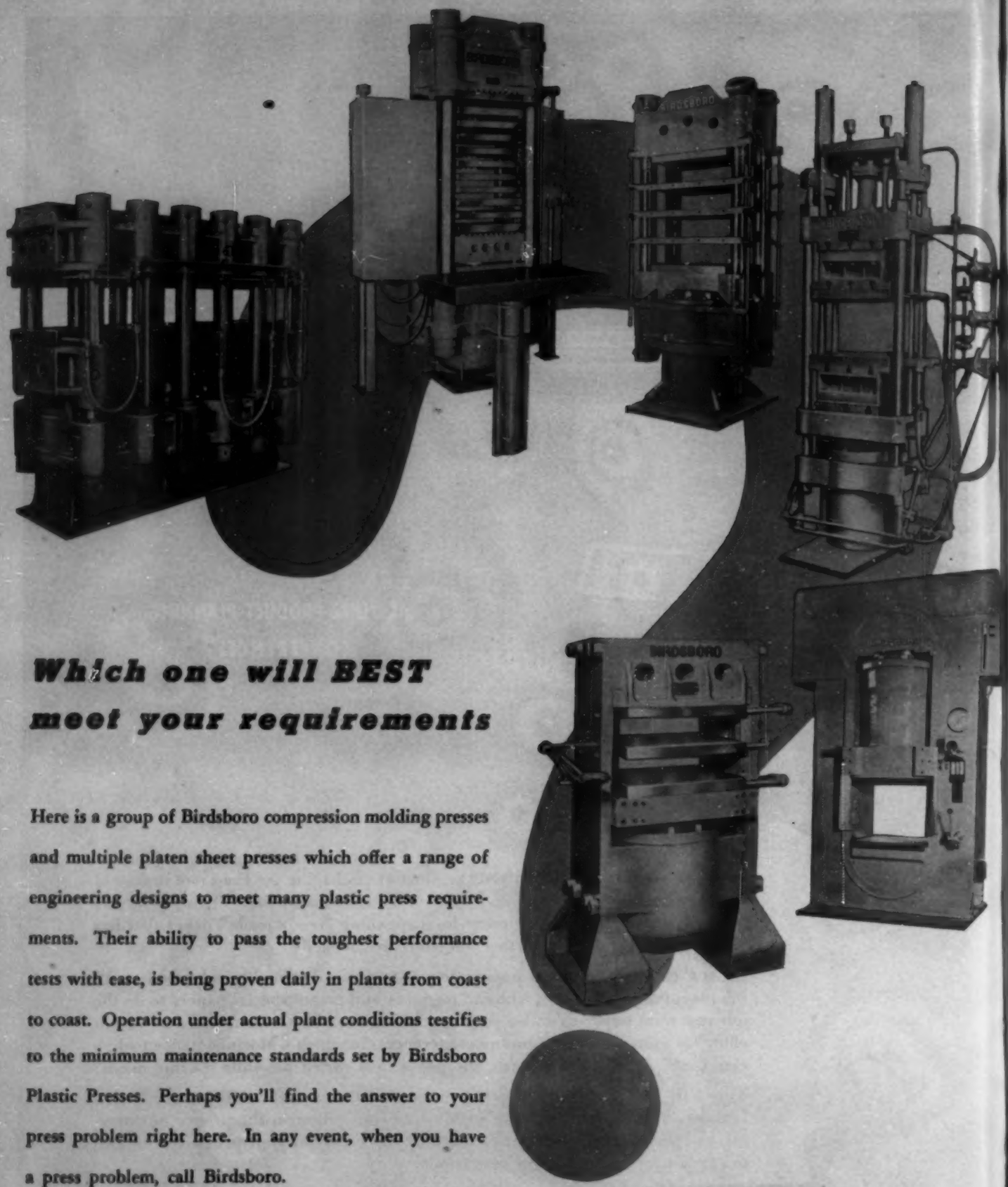
The Mills of Mosinee are qualified by experience and facilities to fill that "vacant chair" . . . to cooperate with your organization in the proper engineering of special paper to improve not only the utility of your products, but also to speed up your processing operations!

Please address your letter "Attention Dept. A"

MOSINEE PAPER MILLS COMPANY

MOSINEE • WISCONSIN

Essential Paper Makers



Which one will BEST meet your requirements

Here is a group of Birdsboro compression molding presses and multiple platen sheet presses which offer a range of engineering designs to meet many plastic press requirements. Their ability to pass the toughest performance tests with ease, is being proven daily in plants from coast to coast. Operation under actual plant conditions testifies to the minimum maintenance standards set by Birdsboro Plastic Presses. Perhaps you'll find the answer to your press problem right here. In any event, when you have a press problem, call Birdsboro.

Birdsboro Steel Foundry & Machine Co • Birdsboro, Pa.

BIRDSBORO

HYDRAULIC PLASTIC PRESSES

PROVEN

on the production front

The order of the day is more and faster production. Many manufacturers have found the answer to this urgent demand by the use of one or more of the Graphitic Steels — Graph-Al, Graph-Mo, Graph-Tung, Graph-M.N.S.

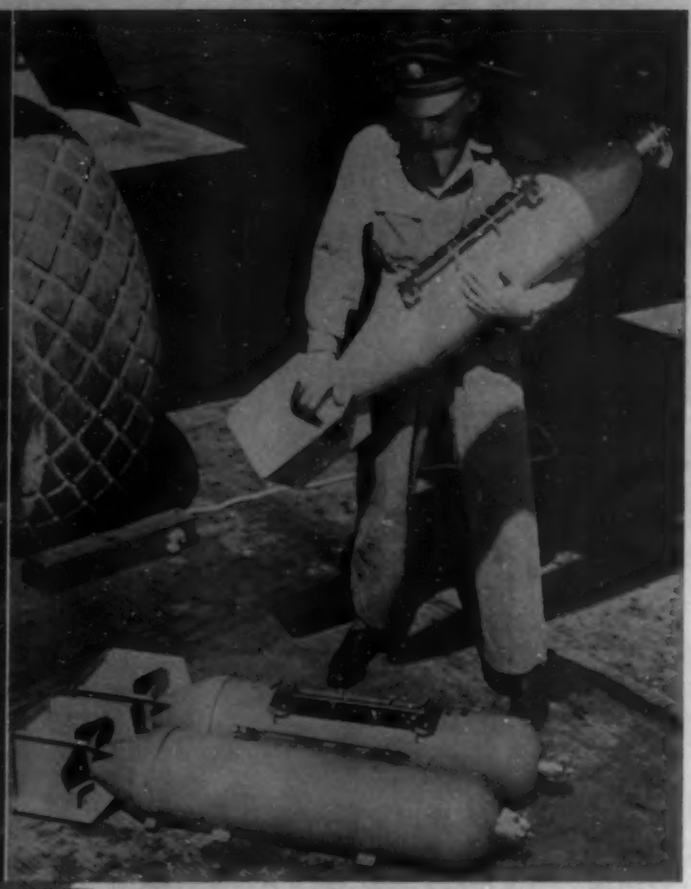
In a wide series of applications on the actual production front the Graphitic Steels machined at least 25% faster than competing steels, they wore longer and had less tendency to score work. Because each of these steels have been designed to do a specific job, it will pay you to investigate the possibilities they offer in speeding production in your shop. A Timken Engineer will be glad to make the proper recommendations for your particular job. Steel and Tube Division, The Timken Roller Bearing Company, Canton 6, Ohio.

Write on your business letterhead for your new copy of the 9th revised and enlarged edition of the illustrated 48 page booklet of Graphitic Steel.

TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

ALLOY STEELS



U.S. ARMY AIR FORCE PHOTO

The "Focus Cats" are on the Prowl over Fortress Europe Tonight

WHEN you pick up your paper tonight and read of another relentless Liberator, Fortress or Lancaster bombing attack, the kind which are gradually pulverizing Nazi industry into a pile of so much brick dust, say a prayer for a fearless little group of flyers who, days ago, armed with only a battery of cameras, flew up and down *Ack Ack Alley* in a hail of hot steel to make it all possible.

These flyers, affectionately dubbed the "Focus Cats," are the Photo Reconnaissance group working with the Eighth Air Force. Prowling the backyards of Hitler's Fortress Europe, they have already mapped a good part of what is to be the Second Front. Their work is picking the targets for tomorrow. Their lenses have been trained on every acre of ground over which, eventually, Allied soldiers will drive toward Berlin. When the time comes, Allied troops entering occupied countries, even Germany, will be familiar with every foot of terrain that lies ahead.

The large missiles pictured above, wicked enough looking to be their death-dealing cousins, are flash bombs—but one of the highly important manufacturing tasks in chemical engineering assigned to McAleer. Timed to explode out of the camera field, they turn darkest night into daytime brilliance and make picture taking possible from as high as four miles above the ground.

Military pyrotechnics alone are not all of the *For-Victory* products of the McAleer Company. There are others which extend into the fields of military aeronautics and hydraulics—yes, and embrace our complete industrial finishing facilities as well. *ON THE HOME FRONT* we fight the war, too . . . by furnishing *quality-controlled* finishing materials and methods which help most industries contribute more to the war effort. If increased finishing efficiency can help YOUR war effort, our advisory facilities are at your service.

McAleer
MANUFACTURING CO.

Manufacturers of Quality Controlled Finishing Materials

ROCHESTER, MICHIGAN

YOUR NEW YEAR'S RESOLUTION

As you face the New Year, the one in which most of us expect at least partial peace to be declared — we suggest you add one resolution to your list:

Find out about plastics extrusion.

We will be glad to tell you about what plastics extrusions have done in many industries. We have been fortunate as the originator of the modern *dry*-process extruding. As the first in the field, we have been privileged to contribute some of the pioneering applications of the process to entire industries: automotive, refrigeration, furniture in peacetime — and to many branches of the Army and Navy in war.

After the war, MACOID extruded plastics will have much to offer to both new and improved products in all fields. Many manufacturers are investigating their possibilities now.

We also do injection molding.

DETROIT MACOID

CORPORATION

12340 Cloverdale Ave. Detroit, Michigan

ORIGINATORS OF DRY PROCESS PLASTIC EXTRUSION

LAST MONTH HE WAS SANTA IN THE TOY STORE

THIS MONTH HE TOOK HIS

GRANDSON'S PLACE

AND HE'S DRIVING SCREWS LIKE A 21-YEAR OLD.

FOR THE PLANT WHERE HE WORKS USES THE RECESSED HEAD

SCREW THAT MAKES DRIVING DUCK SOUP...

IT'S PHILLIPS ➡➡➡➡

Anyone can drive Phillips Screws! Today, screw driving is one production job anyone can tackle without any special talent or training. The job that once called for strong arms and skilled hands now is a cinch for the operator who never tackled a screw driving job before!

It's the Phillips Recessed Head Screw that does the trick! With Phillips Screws, the greenest operator quickly becomes as skillful as a veteran. No fumbling . . . no wobbly starts . . . no slant-driven screws or dangerous screw driver skids. Workers turn out flawless jobs every time — and faster than ever before. Time studies prove that Phillips Recessed Head Screws step up screw driving speed as much as 50 per cent!

Imagine what this means to you in terms of man-and-training-hours saved . . . of increased production . . . finer workmanship. Then match these important advantages against slotted head screws — or any other type you may be using.

PHILLIPS Recessed Head SCREWS

WOOD SCREWS · MACHINE SCREWS · SELF-TAPPING SCREWS · STOVE BOLTS

TO MAKE WARTIME QUOTAS AND PEACETIME PROFITS

Faster Starting: Driver point automatically centers in the Phillips Recess . . . fits snugly. Fumbling, wobbly starts, slant driving are eliminated. Work is made trouble-proof for green hands.

Faster Driving: Spiral and power driving are made practical. Driver won't slip from recess to spoil material or injure worker. (Average time saving is 50%.)

Easier Driving: Turning power is fully utilized. Workers maintain speed without tiring.

Better Fastening: Screws are set-up uniformly tight, without burring or breaking of screw heads. The job is stronger, and the ornamental recess adds to appearance.

IDENTIFY IT!

Center corners of Phillips Recess are rounded . . . NOT square.

Bottom of Phillips Recess is nearly flat . . . NOT tapered to a sharp point.

23 SOURCES

American Screw Co., Providence, R. I.
The Bristol Co., Waterbury, Conn.
Central Screw Co., Chicago, Ill.
Chandler Products Corp., Cleveland, Ohio
Continental Screw Co., New Bedford, Mass.
The Corbin Screw Corp., New Britain, Conn.
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Whitney Screw Corp., Nashua, N. H.

VIRGINIA-LINCOLN CORP.
MARION, VIRGINIA

Valinite

THE Big NAME IN LOW-PRESSURE MOULDING

We only wish we could talk of what we are making now — we would like to show you pictures. But war restrictions make this impossible. However, we CAN tell you that we are delivering reinforced plastic structures to our armed forces.

AS SMALL AS A TEAPOT . . . OR . . .

BIGGER than a BOX CAR . . .

Our entire organization is devoting 100% of its time to war production—our staff of engineers is at your disposal to take care of your problems. There are none too large —none too small. Send us your inquiries. VALINITE can also be used advantageously and profitably in thousands of peacetime applications. May our Postwar Planning Bureau help you?

VIRGINIA-LINCOLN CORP.
Valinite
Reg. U.S. Patent Office

VIRGINIA - LINCOLN CORPORATION
MARION, VIRGINIA

Will PLASTICS

Revolutionize Industry?

We do not think so, not for a long time at least, but we do expect plastics to assume far greater importance in post-war engineering, architecture, and manufacturing operations than ever before.

Plastics are not likely to perform miracles, but if your business or employment involves products of wood, leather, metal, paper fabrics, rubber, ceramics, or coating materials, *you cannot afford to ignore plastics in your post-war plans.*

The impetus of war research; the discovery of new materials and new methods; the eminently satisfactory performance of plastics in replacing older materials during war is bound to bring manufacturing economies and improved consumer goods when peace returns.

The intelligent use of plastics can be determined best by knowing their limitations as well as their advantages; by studying their make-up and physical properties; by recognizing the peculiar characteristics attributed to each type of plastics material.

Such knowledge and information is available through Educational Courses prepared and conducted by

Plastics INSTITUTE

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NUMBER 7 IN A SERIES OF EDUCATIONAL ADVERTISEMENTS ON TRANSFER MOLDING

LOWER MOLD COST

Since rapid production can be achieved with TRANSFER single-cavity molds, on many types of pieces, TRANSFER MOLDING allows the use of molded thermosetting materials on many jobs which would not be economically feasible for compression molding.

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—on thermosetting plastics.

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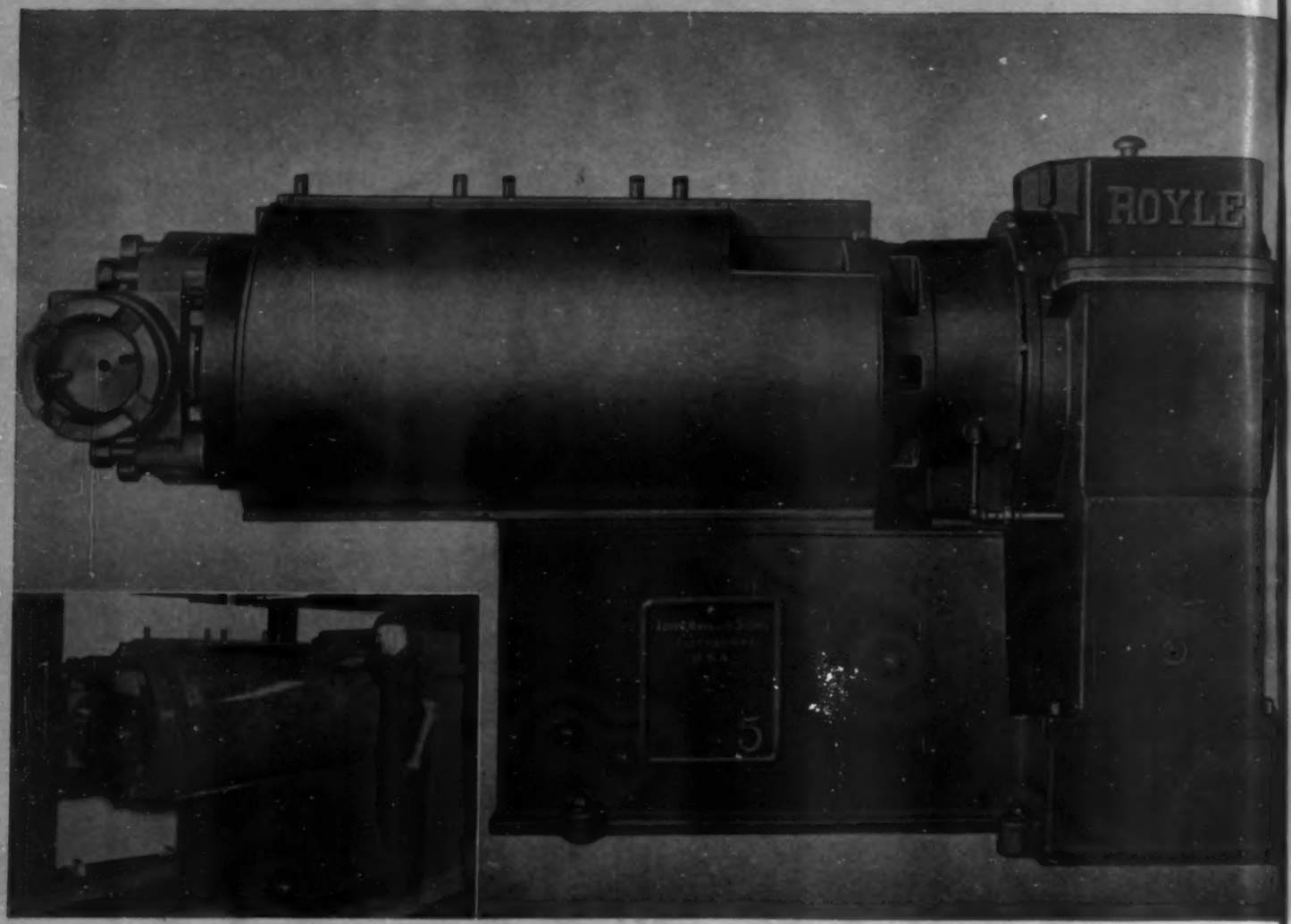

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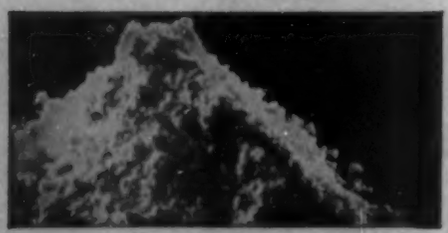

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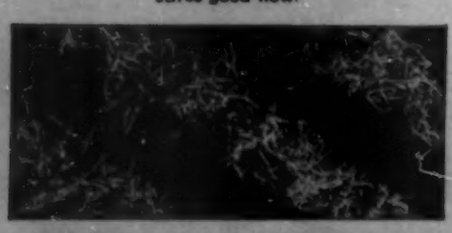

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You may draw freely upon the knowledge and wide experience of C. P. C. We will work with you to solve any liquid resin problem. We will develop a new liquid resin, should your application require it; or we will gladly discuss with you the possible advantages of using liquid resin in any operation or process, present or contemplated, for immediate or postwar production. Write Central Process Corporation, 1401 Circle Avenue, Forest Park, Ill.

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MODERN PLASTICS

JANUARY, 1944 VOLUME 21 NUMBER 5

Allocations of plastics

CLINTON P. RECTOR

Clinton "Pete" Rector became Chief of the Plastics Section, WPB, January 1, succeeding Frank Carman who resigned to become general manager of PMMA. Mr. Rector, who has been connected with the plastics industry since his graduation from Johns Hopkins University, has served WPB for the past 19 months, first as head of the Thermosetting Unit and then as Deputy Chief of the Plastics Section.

"SHIPS and More Ships!" "Planes and More Planes!" These have been our slogans through the defense days prior to Pearl Harbor and through the era of vigorous war production which has followed. Since synthetic resins and plastics are used extensively in the manufacture of planes, ships, tanks, jeeps and practically all other combat equipment, a huge new demand has been placed upon the plastics industry. As a result, sufficiently acute shortages of 15 different plastics—ranging from the vinyl copolymers to the urea formaldehyde materials—have been created to necessitate allocation control as a means of insuring the most effective distribution of the available material.

In the initial stages of these shortages of plastic materials, an effort was made to fulfill satisfactorily our war needs through the issuance of ratings sufficiently high to insure that the material required for military purposes would be provided before any plastic was made available for less important purposes. However, this type of control soon proved to be unreliable due to the multiplicity of government agencies through which ratings could originate and the impossibility of maintaining a unified rating policy throughout these various agencies. It was found that some uses of extreme importance were covered by relatively low ratings while articles of an unessential character sometimes carried the highest available ratings.

As a result of this experience, the allocation type of order was developed. Several types of control are available through an allocation order, and a choice must be based on a careful study of the various factors involved. If the fundamental problem is simply one of eliminating diversion from existing uses to a new use or to a network of uses which are of an unessential character, an order involving restriction to the rate of consumption which prevailed during a prior base period may be employed. If the material in question is available at a constant rate and the uses which must be maintained are non-fluctuating, a simple limitation order excluding unsound uses may suffice. If on the other hand, the supply is highly variable, an allocation order might be used as a means of distributing the available material to the necessary uses on a "base period" percentage basis and excluding those uses which are of a secondary nature, and which, if allowed to persist, would interfere with previously established vital uses.

In the case of the plastic materials the reverse situation has prevailed. New war uses were developed for these materials which previously had been employed for the manufacture of civilian products. In many instances, the total available material was insufficient to satisfy all of the war uses. As a means of insuring the optimum utilization of this supply, an allocation order on the basis of specific end use was indicated. During periods of extreme shortage close collaboration between members of the Armed Services, plastics manufacturers, plastics users and WPB specialists has been necessary to avoid serious interference with the war effort.

One of the most common situations confronting the administrator of an allocation order is the need to distribute a plastic which is of limited availability because of restricted production of some raw material

needed for the manufacture of the plastic in question. In such instances, the administrator must predicate his actions solely upon a careful determination of the total amount of the limiting raw material that is available. It is not necessary for him to concern himself with the productive capacity in the possession of the producers. If, on the other hand, all necessary raw materials are in free supply, the total availability is limited solely by the ability to transform these raw materials into plastics.

Under these circumstances a network of specific "bottlenecks" or limiting factors must be taken into account by the allocator. Each type and grade of plastic has its own chain of required manufacturing facilities. Obviously the total availability of the material is no greater than the capacity of the smallest unit involved. For example, the making of a given grade of material may require the use of a high pressure reactor, a vacuum drier, an impact grinder, a blender, a Banbury mixer and a calendering mill. To illustrate a typical problem confronting the allocator, assume the productive capacity of the blender to be only one-half that of the grinder, the next smallest "link" from a productive capacity standpoint. It immediately becomes evident that the allocations of the blended grade must not exceed 50 percent of the total that is available. The administrator has the responsibility of seeing that the blended material is placed in the hands of those applicants who have the most vital need for this grade of plastic. The remaining requirements are filled with unblended material. Even in those instances where both immediate raw materials and productive capacity are apparently available, some restriction may still be necessary. The more prevalent reasons for this situation are as follows:

1. The use in question is not sufficiently important to justify the manpower involved, either direct or for the production of some raw material to be used in the making of the plastic desired.

2. Some specific chemical or other raw material needed for the making of a component part of the plastic cannot be provided since the available supply is needed for more important uses.

3. The use in question is not sufficiently vital to the war effort to justify the necessary shipping space (either domestic or ocean freight) or to warrant the expenditure of some other comparable service.

At various times and particularly in some localities, it may be impossible to provide plastic components for a use of secondary essentiality because the supply of fuel oil, process steam or electric power is such that the material under consideration cannot be produced without interference with more important work. One of the responsibilities of the administrator of an allocation order is to be continuously aware of these and other factors which bear upon the overall availability of the commodity for which he is responsible. His decisions must be predicated upon an evaluation of such factors in addition to considerations of the fundamental essentiality of the item to be produced. Irrespective of the essentiality level surrounding a given material, the allocator must not, under any circumstances, issue authorizations exceeding the total availability since it is extremely disturbing to members of the industry to find that an authorization is worthless due to the inability of suppliers to make delivery against it.

There are many factors which bear upon the relative essential character of any use under consideration. The basic problem is whether or not the commodity or device to be made is sufficiently important to the war effort to justify its production. If the answer to this is in the affirmative, the next question to be considered is how essential is the plastic in question to the use at hand.

If there is an alternate material equally satisfactory for the product under consideration which is more readily available, the allocator may conclude that the application should be denied. Under these circumstances an alternate material is suggested and the material under allocation is made available for some equally important use where substitution is not readily practical.

In the administration of an allocation order, the degree of control that is necessary varies with the relative availability. When the total supply is inadequate to provide for all important uses, the closest possible attention must be devoted to all factors cited above which bear upon the practicability of authorizing the manufacture of a given item. In those cases where supply and demand are in relative balance, it becomes unnecessary to maintain such close scrutiny of the various factors.

If for several consecutive months, it has been possible to provide all of an allocated plastic that was demanded for important uses, it may become practical to repeal the order in question and replace it with a simple limitation order designed to eliminate those uses which obviously will be impractical for the duration of the war but otherwise permit the material to be distributed without specific authorization. In those cases where this type of control is considered inadequate in the light of an improved availability, the allocation procedure may be simplified by increasing the size of the small order exemption or by placing it on a quarterly basis or some other form of revision.

The Plastics Section of the War Production Board is keenly aware of the desirability of simplification wherever it can be effected without danger of interference with the war effort. Already it has revised several of the allocation orders with a corresponding saving in paper work. It is probable that further alterations will be made within the next 60 days.

C. Rector

ALL PHOTOS, COURTESY BAKELITE CORP.

1—Using a Mark V surface lookout alidade in combination with binoculars, this lookout can accurately locate surface objects

"Sighted sub, sank same"

by LESLIE C. MACKRILL*

A SECOND'S delay or an error in reporting the exact position of an enemy ship can change tomorrow's headlines. Failure of a Navy lookout to detect immediately and accurately the location of a German or Japanese submarine or surface vessel may result in a harrowing front-page story of the sinking of one of our warships. Fast, precise action, on the other hand, is the type that forged the familiar headline "Sighted sub, sank same."

Much of our success in battling enemy submarines and raiders can be attributed to the surface lookout alidade with which the Navy is equipping many of its vessels. This instrument enables a lookout to measure the relative bearings of a surface object and thus determine its distance. It is designed to operate in combination with binoculars—holding and rotating with the searching movement of the glasses. When the target is stationed in the binocular field of view, the alidade's dial which is conveniently located just below the glasses, indicates an azimuth reading of the target angle with respect to the fore and aft line of the searching vessel (the fore and aft line being 0° and 180°). This information is telephoned immediately to the range-finder station as are similar readings from alidades stationed at other points on the ship.

The number of alidades required aboard a ship depends upon the number of lookout stations. This, in turn, depends on the type and size of the vessel. Each lookout is stationed at a spot where he has an uninterrupted view of a certain sector of the horizon and the intervening water. The total complement of lookouts scans a full 360° with one sector overlapping another when the number of stations will permit.

The alidade which was being manufactured at the outbreak of the war consists primarily of two cast aluminum parts: 1) a body which is bolted to the bulkhead and contains two ball bearings for the center shaft, and 2) the carriage with binocular holder which rotates about the center shaft and a fixed bevel gear. A meshing bevel gear and shaft carrying a 3-in. diameter dial, and two lamp holders comprise the remaining parts.

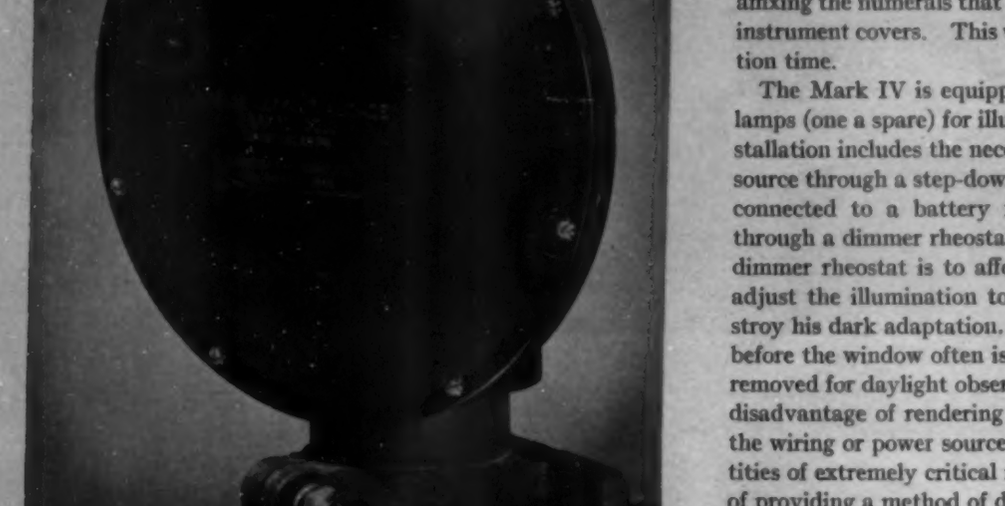
Some time ago when our output of naval vessels was increased sharply, it became obvious that the production of aluminum Mark IV surface lookout alidades would have to be

* Engineer, Bureau of Ships, U. S. Navy Dept.

stepped up considerably if certain of these ships were to be adequately supplied with lookout equipment. But aluminum was vitally needed for the manufacture of aircraft and a multiplicity of other equipment such as binoculars and sextants, instruments used in navigation, which must necessarily be kept light in weight. More important, the machinery and skilled labor necessary to fabricate steel gears and machine castings were exceedingly critical. These factors created a bottleneck in production of the instruments in the quantities desired.

There were other features about this aluminum model that suggested the possibility of improving the operating efficiency of the instrument. An approximate 4 to 1 gear ratio between the main shaft and the dial shaft produces practically a complete rotation of the 3-in. dial which is graduated by perforated indicia for 90° of rotation. Since each alidade must read relative bearing, that is, relative to the fore and aft line of the ship which is 0° and 180°, and since the dial shows only 90°, it is necessary to disassemble each aluminum alidade after installation and calibration in order to remove the dial for affixing the numerals that correctly indicate which 90° arc the instrument covers. This work adds materially to the installation time.

The Mark IV is equipped with receptacles for two 6-volt lamps (one a spare) for illuminating the dial at night. The installation includes the necessary wiring from the ship's power source through a step-down transformer, a changeover switch connected to a battery for emergency power and thence through a dimmer rheostat to the lamp. The purpose of the dimmer rheostat is to afford the lookout an opportunity to adjust the illumination to a low intensity that will not destroy his dark adaptation. For night observation a red filter before the window often is found necessary—a filter which is removed for daylight observation. This arrangement has the disadvantage of rendering the instrument useless at night if the wiring or power source should be damaged, of using quantities of extremely critical material in the lighting circuit and of providing a method of dial illumination that had to be improved to preserve the observer's dark adaptation. Over and



2—Except for a metal center shaft, the new alidade is molded entirely of plastics.
3—Body or housing (B), cover (A) and base (C) are molded of impact-resistant phenolic material. The base, molded about a steel guide sleeve insert, is recessed at the top to carry the thrust ball bearings for the shaft

above these shortcomings of the Mark IV there was need for a modified and improved instrument that would function efficiently under all climatic and service conditions.

The design engineers of the Navy turned to plastics for the solution of the problem of an instrument that could be produced rapidly and cheaply in large quantities with a minimum of skilled machine tool labor and an avoidance of the use of more critical materials. Since the scope and field of operation of the new alidade was intended to be much broader than that of the aluminum model, it was possible to start from scratch and plan the design in accordance with the best plastic practice. A group of molders invited to Washington to study the plans and make comments, first considered whether the various parts were practical from a molding standpoint and could be produced on existing equipment. After suitable equipment was found that was open for production, the complete design for the alidade was gone over again with the idea of eliminating costly machining hours. More consultations were held by the Navy designing staff and the molder to discuss the functional requirements—taking into consideration the limitations of molding practices.

Finally a full scale working model was built. This alidade was intended as a check not only upon the various plastic parts but on the proper operation of the complete assembly. The model showed that only slight changes of the design as originally laid out were necessary. The building of the model, however, presented a visual understanding of the over-all problems that could not have been obtained from the drawing only and thus greatly facilitated the building of tools.

Molded phenolic material was chosen for the new Mark V alidade in order to achieve accelerated, less expensive production, and to save critical materials, man- and machine-hours. Radioactive material was selected as a means of illumination for two reasons: 1) to eliminate the use of extremely critical copper wire; rubber-covered flexible electrical cables; switch, transformer and rheostat components; batteries required to serve as a source of emergency illumination; and time-absorbing labor required to install this material, and 2) as a means of better preserving the dark adaptation of the observer by illuminating the dial with a radioactive material, colored in the red portion of the spectrum. Since this material is a self-contained source of illumination, it is not likely to fail at a crucial moment. The incorporation of a 360° graduated dial in the new instrument eliminated the need for disassembling the instrument after installation in order to apply the dial numerals, or the need for procuring a new dial in the event it became desirable to change the location of the instrument.

Shown assembled in Figs. 1 and 2 is the Mark V alidade consisting of a stainless steel shaft bearing the binocular holder (Fig. 3B), molded into a rotatable phenolic body or housing so shaped in front as to accommodate a $7^{5}/_{8}$-in. diameter rotatable dial, the axis of which is perpendicular to the shaft. Covering the dial and attached to the housing is a molded phenolic dished removable cover (Fig. 3A) in which is secured a molded polystyrene window (Fig. 4) for viewing

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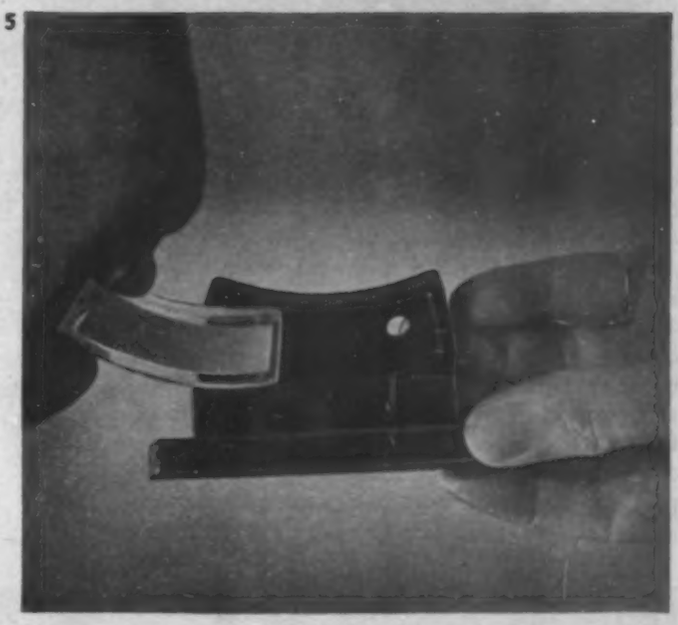

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4—Polystyrene window for viewing graduations is molded to dimensions of receptacle opening in cover. 5—Radioactive material is contained in a polystyrene cell molded to fit into removal phenolic holder. 6—At rear, compression molded phenolic holder for radioactive-material-filled cell. At left, window, and right, cell, both injection molded of transparent polystyrene

the dial graduations. These component parts, assembled as a unit, rotate with the steel shaft which passes through a separate cylindrical molded phenolic base. The base (Fig. 3C) is molded about a steel guide sleeve insert and is recessed at the top to carry a radial and thrust ball bearing upon which the steel shaft rotates. A separately molded bevel gear (Fig. 7A) (pitch diameter 3 inches, number of teeth 50) is concentrically positioned about the top of the cylindrical phenolic base and secured by means of machine screws. An identical bevel gear is molded integral with the dial mount which is recessed for a double row ball bearing upon which it rotates. Secured to the periphery of the dial mount (Fig. 7B) is a brass conical faced dial, painted black and graduated in degrees through 360 by perforated indicia. Rotation of the shaft carrying the binocular dial and housing, about the fixed base will cause the dial gear to rotate about the fixed base gear, thus rotating the dial and registering the correct relative bearing of any object within the range of the alidade.

Secured in a recess in the top of the housing is a removable molded phenolic holder (Figs. 5 and 6) for the molded polystyrene cell containing radioactive material. This cell is positioned in back of the dial and in line with the window in the cover. Reference indicia in the window is obtained by sealing two $^1/_{32}$-in. diameter glass tubes filled with radioactive material into grooves provided in the inner surface of the window in opposite positions, one above the dial graduations and one below the dial numerals. The radioactive material behind the dial and in the glass indicia in the window is colored in the red end of the spectrum and may be readily seen both in daylight and in darkness. However it will not affect the dark conditioning of the observer's eyes for night observations. The rotatable index dial, mount and gear assembly is mounted on a shaft perpendicular to the main shaft and adjustable both horizontally and vertically for the purpose of obtaining perfect meshing with the matching bevel gear that is fixed to the stationary phenolic base. These adjustments are made during assembly and the parts firmly locked in the desired position. No further adjustments are necessary unless damage to the instrument calls for part replacements.

The completely assembled instrument is mounted on the bulkhead by means of a cast-steel clamp bracket in which the cylindrical phenolic base of the instrument is clamped (Fig. 2). In the bulkhead and in line with the binocular mounted on the alidade is an opening just wide enough to permit observations through the complete arcuate traverse of the binocular. The alidade may be correctly calibrated for its particular position on board by backing off on the clamp nut of the bracket and training the binocular in the alidade holder on an object of predetermined relative bearing. Then the instrument base is turned in the bracket until the dial registers the correct bearing. Having completed this simple operation and tightened the clamp nut above the base, the alidade dial will register and correct relative bearing of any object within the arcuate range of the instrument.

The dished removable cover, gears and luminous plate holder are compression molded in positive molds. The base and main housing are transfer molded to insure that the stainless steel bushing and central shaft are held in a central position and that the moldings are kept free of gas pockets, especially in the heavy section, without recourse to extremely long heating and cooling cycles. Injection molding is used for the window and luminous plate.

While all the parts were molded to close practical tolerances, final machining is performed on those pieces where greater accuracy is required. In most cases, .010 to .015 additional stock is ample for these finishing operations which consist of diamond turning the back surface of the gear parallel to the pitch line of the teeth and boring operations for ball-bearing rotations. There are, of course, the usual drilling and tapping operations for the smaller holes.

A series of complete sample Mark V alidades were submitted to impact tests on the Navy medium shock stand. Each sample contained parts molded of different materials which had been selected as a result of each successive test. The test consisted of a total of six 2000 ft.-lb. blows—two 2000 ft-lb. blows parallel to each of the three principal axes of the instrument. The test stand consists of a steel plate upon which the equipment to be tested is (*Please turn to page 184*)

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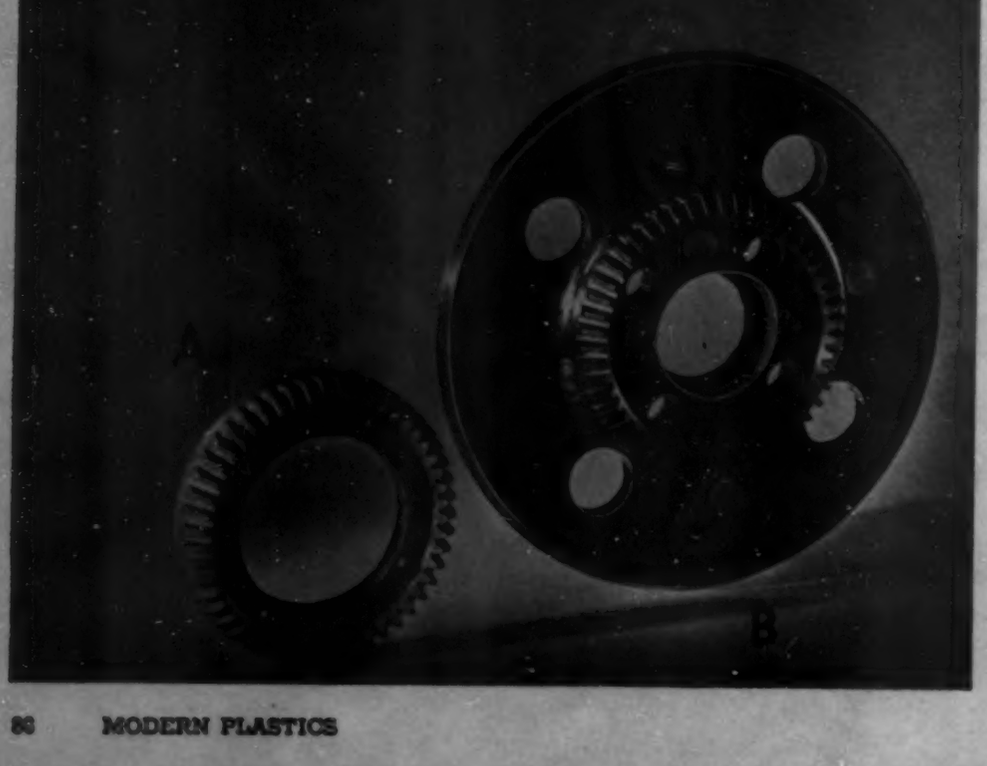

7—Bevel gear (A), compression molded of macerated fabric-base phenolic, has exceptionally high impact resistance. An identical bevel gear is integral with the dial mount (B), also compression molded

PHOTO, COURTESY WOOD RUBBER CO.

This group of plastic-wood fiber trim parts includes aileron flettners, aileron trim tabs, elevator tabs and rudder tabs in various stages of assembly. In the foreground are assembly parts

Glider control tabs

"HELLO, glider. Hello, glider. Tug calling. You can cut now. You can cut now." A moment after these instructions are radioed from the towing plane, the glider releases itself from the cable. And at that instant responsibility for a successful landing passes to the glider control parts.

In the new 15-place troop glider, CG4A Haig, the trimming controls are compression molded of thin mahogany veneer and cotton fiber impregnated with thermosetting, phenol-formaldehyde resins. Preliminary specifications for this ship were quite general, but there were two important stipulations. The first requirement was that only non-strategic materials be used; the second that non-skilled labor was to be preferred. The design which was accepted by Army Air Force officials specified a light metal frame and plywood wings and controls. However, shortly after the program started, a Massachusetts company was asked to develop a plastic plywood construction for the aileron flettners, aileron trim tabs, elevator tabs and rudder tabs. This alternate material proved to be lighter in weight, stronger and to possess improved moisture absorption characteristics.

Having passed their tests, these plastic-wood fiber trim parts now are under nonstop production with a goal that may well reach 10,000 gliders capable of transporting as many as 150,000 fully equipped soldiers behind fast-moving planes Recently a Waco CG4A Haig made aviation history in a trans-Atlantic tow crossing, and when the pilot gave his ship rudder and ailerons as he headed for a landing on English soil, he was maneuvering with the new plastic controls.

The glider's 6 trimming tabs are being produced by this New England subcontractor on the basis of mass-production, assembly line techniques. After the thin mahogany veneer and cotton fiber enter the plant, the first step is the resin impregnation of the prepared cotton fibers. These sheets are machine-dried following their saturation in a resin bath. Similarly, the strips of mahogany veneer, paper thin, are saturated with liquid resins and then hung to dry. These wood strips are available in any desired length when the veneer is running with the grain, but cross grains usually are limited to 8 or 12 in. in width.

Following the impregnation process the two materials are brought to the Prep Department where preforms are made up. Since each of the trim parts varies in size and thickness, a different preform is needed for each glider control. For example, flettner tabs measure 61⅝ in. in length while elevator tabs are about half as long—25 in. in length.

The skin portion of these control parts consists of layers of veneer and cotton fiber. Since equal strength in all direc-

ALL PHOTOS, COURTESY HOOD RUBBER CO.

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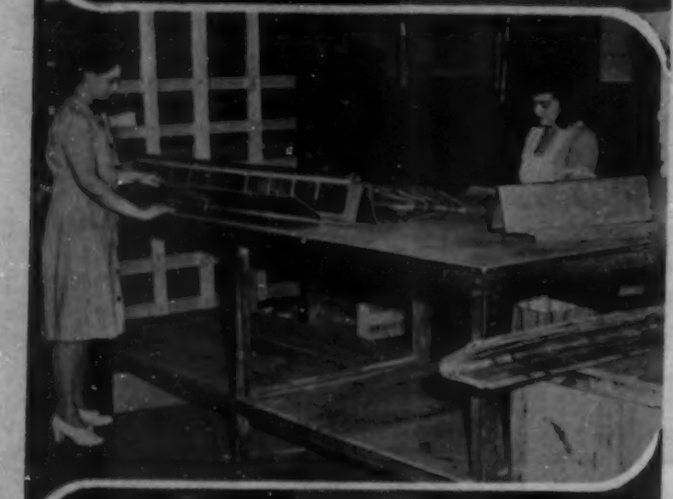

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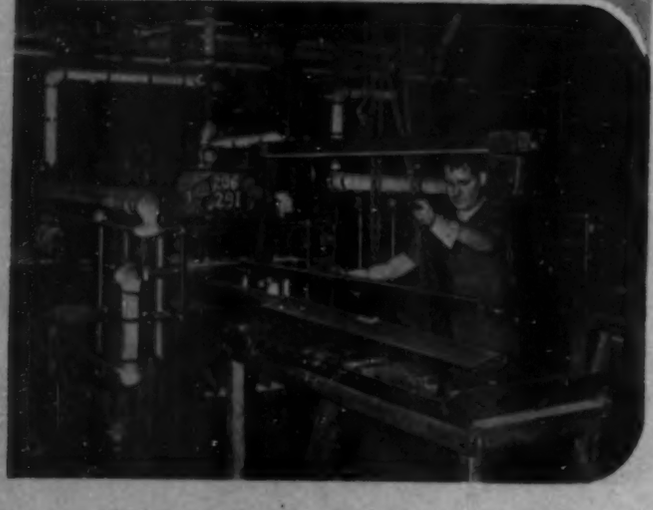

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tions is desirable, direction of the wood grain is varied when the sheets are placed on the preform. In addition to cross plying the wood, the layers are so arranged that the outside surface always is fiber. This type of construction provides resistance to riveting tear during actual flight and tends to ward off the damaging effects of moisture.

After a preform has been built up with a predetermined number of alternate layers of fiber and wood, the entire panel is fastened along the outside edges. This tacking holds the material firmly in place prior to molding. However, before going to the molding room, all skins undergo preform cures in cold presses utilizing hot plates. The plates are preheated, and the skin panels cold-pressed for a short period. This preforming simplifies handling of the large pieces in the hot press procedure. It would seem that stamping together of the fiber and wood veneer in this short operation might have an advanced polymerization effect, but upon emerging from the plates the surface still is unpolymerized.

After the preform stage each control tab is given individual treatment. In the case of the aileron flettner, the preformed skin is delivered to the finishing room where operators prepare the inner skin surface at all spots where it makes contacts with the nose and tail ribs, spars and bulkheads. For this work templates are used as guides to the exact location of the reinforcing sections. This skin preparation is necessary to insure perfect adhesion in assembly molding operation.

The spar for the aileron flettner is built up of wood veneers which are bonded with phenolic glue. The small, triangular-shaped ribs are composed of layers of impregnated fiber—no wood. They are high-impact molded pieces, preformed in special molds on hydraulic presses by compression molding. The flettner bulkheads, built-up of all-wood, preimpregnated veneers, are molded between plates under heat and pressure. Thereafter they are shaped to form by woodworking tools.

Before insertion in the flettner skin, the bulkheads and ribs are assembled in their proper places along the spar, resin glues holding them in place. This framework then is preassembled with the skin parts and temporarily held in place by a special fastening means. It is at this point that metallic parts such as horn bearings are inserted at their particular location and molded in place. In the assembly operation the blocks to which the horn is attached are resin-bonded to the inner skin surface along both dies. The top or spar side also is bonded so that the block adheres firmly to all surfaces and holds the hardware firmly in place. The assembled tab then is delivered to the press room where the pressure assembly cure completes polymerization of the resin.

The flettner tab, in addition to being hinged in place by means of the horn assembly, gains support from the aileron surface to which it is attached by threaded end bearings. Operating as a slot pivot arrangement, the end bearings are threaded aluminum inserts which are center-driven through the bulkheads at both ends of the flettner tabs. These end bearings are inserted into pivot slots in the aileron surfaces with sufficient clearance to permit free operation of the tabs when the plane is in flight.

Both before and after assembly curing each tab is care-

2—To give equal strength in all directions, the direction of wood grain is varied when preforms for the trim tabs are made up. 3—Preforms are given a thorough inspection before assembly. 4—Framework and skin are temporarily held together by a special fastening means. 5—After assembly, the trim parts are loaded in a mold where the pressure assembly cure completes polymerization

fully examined by means of special devices involving the use of x-ray. These examining units were designed and built by the company's technical staff. After molding, drain holes, properly located by templates, are drilled all the way through the cured skin at various required points. By means of these holes moisture condensation and rain is drained off when the glider is in flight.

As a final operation all flettner tabs are static-load tested to insure their meeting design requirements as regards air load. The tabs are loaded down with lead weights after they have been inserted in a frame similar to that of a glider. If the part carries its static load without serious deflection or permanent set, it is approved. While the maximum load of the long flettner tab is 114 lb., uniformly distributed over the entire surface, the glider manufacturer's requirements indicate 100 percent overload without failure. Consequently, after an initial 114-lb. test, the tabs are subjected to a 228-lb. test which they must pass without failure. Records show that the glider control parts consistently withstand this double pressure. Vibration tests are not required since gliders are not equipped with motors.

The molding of the second control part, the aileron trim tab, approximates that of the flettner tab. In this case the cross-grained fiber and wood-veneer panel measures only 20 inches. After the sheets have been fastened in place with wire stitches, the built-up panel is preformed. Then the single all-fiber spar inner reinforcement is put in place, and the skin of the aileron trim stapled along the trailing edge. The ribs of this control part, 2 nose ribs and 2 main ribs, are resin-impregnated fiber preforms while the 2 bulkheads are of wood. As in the case of the flettner tab the bulkheads feature threaded couplings for slotting into the wing section in final assembly. The metal horn attachment is secured through the skin in the same fashion as it was in the larger aileron control. In final assembly cure the tabs are compression molded in single-cavity molds.

The glider elevator tab consists of double-skin fiber-wood surfaces, fiber ribs and wood bulkheads. These control tabs have streamlined curvatures, and they differ from the aileron trim tabs in that the latter consist of one-piece skins with no joints or seams at the leading edge. The elevator skin panels are built up of 5 layers of the impregnated fiber and wood veneers in a layer construction. Allowing the fiber layers to comprise the outer ply, results in a pleasing yellow thermoset skin after final compression molding in steel molds. Extruded aluminum piano hinges are riveted at 1-in. intervals to the leading edges of the finished tabs.

The rubber tab is constructed in the same general manner as is the elevator tab. It, too, consists of 2 skins, fiber ribs, wood bulkheads and no spar. The part is compression-molded in a single-cavity mold. The temperature and curing cycles are the same as in the case of the elevator tab. In final glider assembly the rudder tab is attached, vertically, to the rudder in a cut out at the trailer edges.

Credits—Material by Monsanto Chemical Co. Fabrication by Hood Rubber Co., for Waco Aircraft Co.

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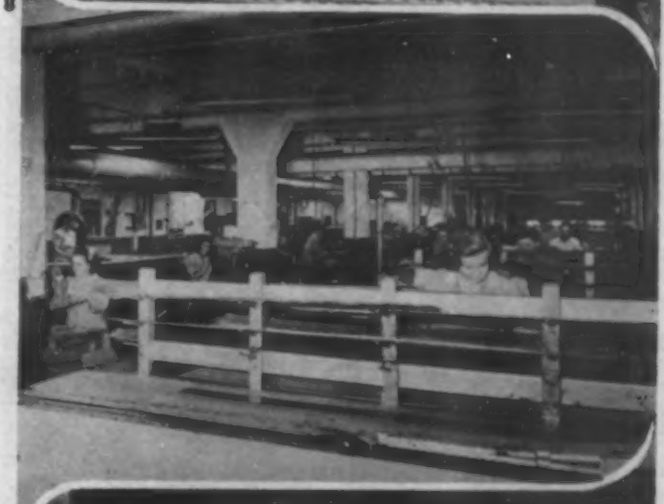

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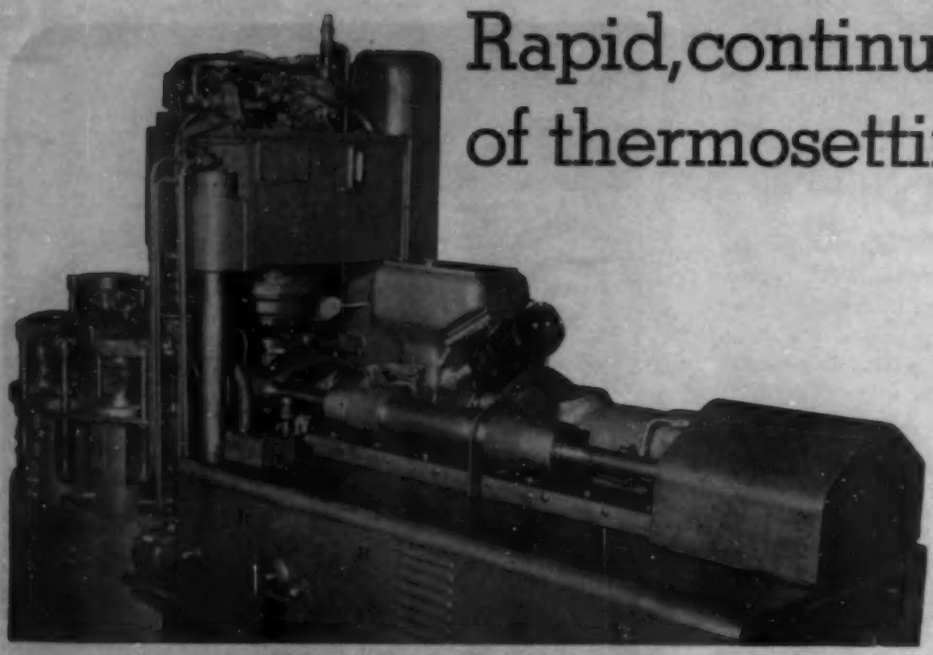
6—This hinge which is being attached to a trim tab helps to hold the assembly in place after the parts are installed on a glider. 7—The horn assembly, the next part to be attached to the tabs, provides the means for hinging the tabs in place. 8—A section of the finishing department. 9—All the finished trim parts are given a fluoroscope inspection after assembly curing

Rapid, continuous injection of thermosetting materials



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1—The hopper from which raw material is fed into a pre-heated cylinder is located in the center of this rotary indexing machine. At left is the rotary indexer with a mold in place, moving through a curing cycle

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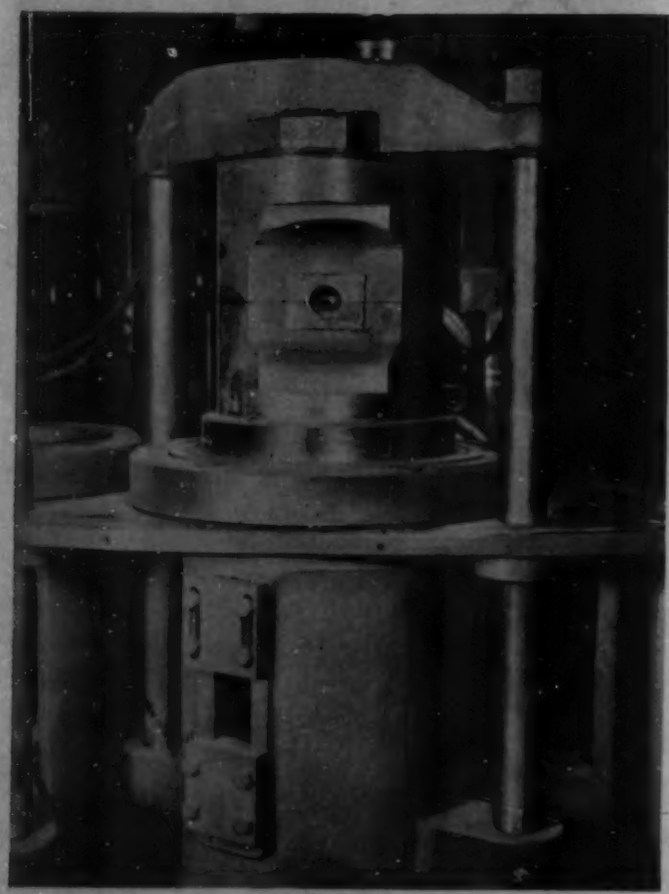

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CONTINUOUS, large-scale injection molding of thermosetting plastics castings has been achieved by the Ford Motor Co.'s plastics department at the River Rouge plant through the successful development of a rotary indexing machine built to Ford specifications. Although the machine still is in the experimental stage, company technicians have demonstrated in the past six months in test runs, the feasibility of continuous, fast injection of thermosetting materials.

Hundreds of truck engine coil cases—some of the more difficult parts to mold because of their odd shape—have been made on this machine. This part calls for a shell of varying thickness, two supports with a wall thickness much greater than that of the case itself, and a nozzle-like outlet which serves as a wire conduit. Today, after six months of experimental operation during which hundreds of coil cases were molded, most of the difficulties experienced in the operation of the machine seem to have been solved.

It is because of the successful synchronization of the machine's three basic operations that the way has been opened to the new large-scale production standards. With perfect synchronization the unit measures into an injection cylinder exact amounts of the raw material to be molded, heats this plastic and injects it under tremendous pressure into an indexing mold, and cures the casting in that die while other housings are being molded. Key to this new machine is the rotary indexer which activates a turntable with a capacity of 12 molds or stations. However, throughout the test runs, only six of the stations were in production, alternate stations being left blank.

In operation the continuous thermosetting plastics injector is similar to an aircraft machine gun synchronized to fire through its revolving propeller blades. Raw material from the elevated hopper feeds into a small cylinder where a slowly revolving screw pushes the proper quantity of material necessary for a single casting into a large cylinder. The amount of this material is controlled by the rate of speed of the feed screw and the length of time it operates. In the larger cylinder, which is surrounded by hot oil, the transformation of the material from a powdered state to a viscous mass begins. The intensity of the heat increases as the plastic progresses toward the nozzle or point of injection, raising the tempera-

ture of the material to be cast to a range of 250 to 280° F. depending upon the plastic involved.

At the point of injection a hydraulic injection clamp which exerts a pressure of 250,000 lb. holds the nozzle in place while the plastic material, now in a viscous state, is forced into an electrically heated mold under a pressure of 40,000 pounds per square inch. Once the casting has been made and the mold released from the injection position, the process of curing the casting under heat and pressure begins. Electrically controlled temperatures of from 300 to 330° F. are maintained in each mold until it is opened to permit removal of the casting. In addition a pressure of 10,000 lb. is maintained on the mold as it revolves through the stations on the indexing machine. This contrasts with the much simpler technique employed for molding thermoplastics where the curing period is a matter of seconds and no heat is required. In production an average of 20 sec. was required for each truck coil cast, although current studies indicate that this time can be substantially reduced.

It was in connection with the rotary indexer, the outstanding feature of this machine, that Ford technicians solved the first of the problems which arose in connection with the unit's operation. Clogging of the injection nozzle as a result of improper timing was the biggest stumbling block. The turntable or indexing table is synchronized to work in conjunction with the injection machinery and the speed of operation is variable. Essentially the speed of injection can be attributed to the fast solidification of all thermosetting compounds.

Test operation of the machine has disclosed several operating advantages which are important in any consideration of large-scale production. Since exact quantities of raw material are measured into the injection cylinder, waste is reduced to a minimum. In addition the castings are free from flash or fins which frequently are encountered in compression molding. Company technicians estimate that the new process reduces molding waste by at least 10 percent, and the saving in labor in trimming of the flash represents an additional 10 percent. Test operations indicate that the continuous injection process produces castings of greater tensile and dielectric strength than are obtained by other methods. There also is a substantial saving in the curing time—estimated to be as high as 250 percent as compared with regular methods. This saving is attributed largely to higher mold pressure. Since fewer dies are required for greater production, a 25 percent saving is achieved in the cost of cavities.

One feature of the machine, which is to be the subject of further experiments, is its versatility. According to company technicians, it would be possible to employ a different mold in each of the 12 stations on the rotary indexer provided all the dies were within the same weight range. To make new parts only the cavity need be changed, not the shoe.

In the course of experimental runs several thermosetting compounds have been employed, but pending further tests company technicians were hesitant about specifying the compounds used or the results obtained in casting. Wartime restrictions have prevented as wide a use of materials as was desired. The same restriction applies to the variety of products turned out by the machine.

Credit—Rotary indexing machine built by Hydraulic Press Manufacturing Co.

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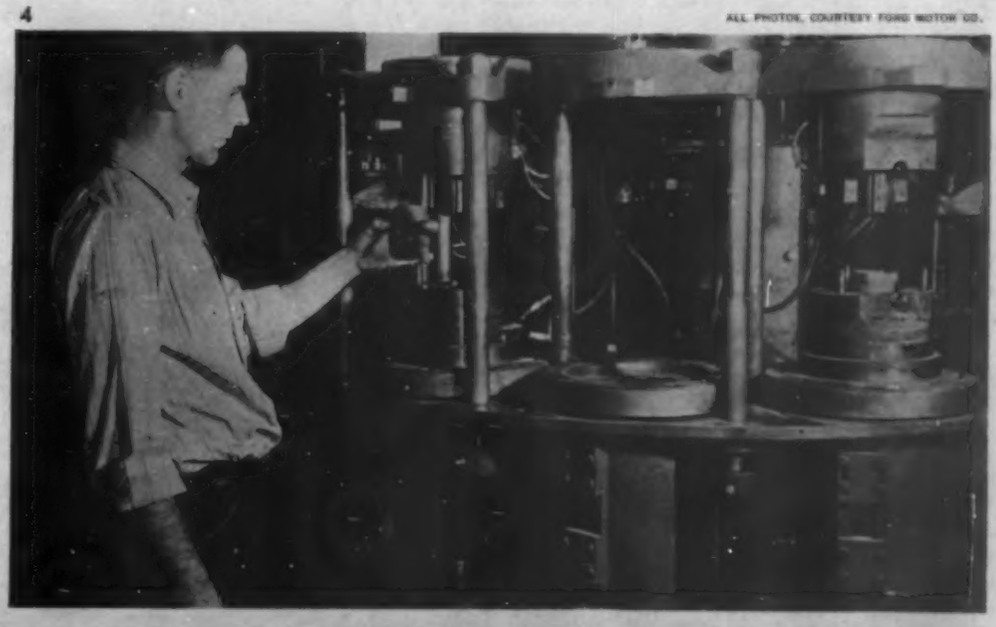
ALL PHOTOS, COURTESY FORD MOTOR CO.



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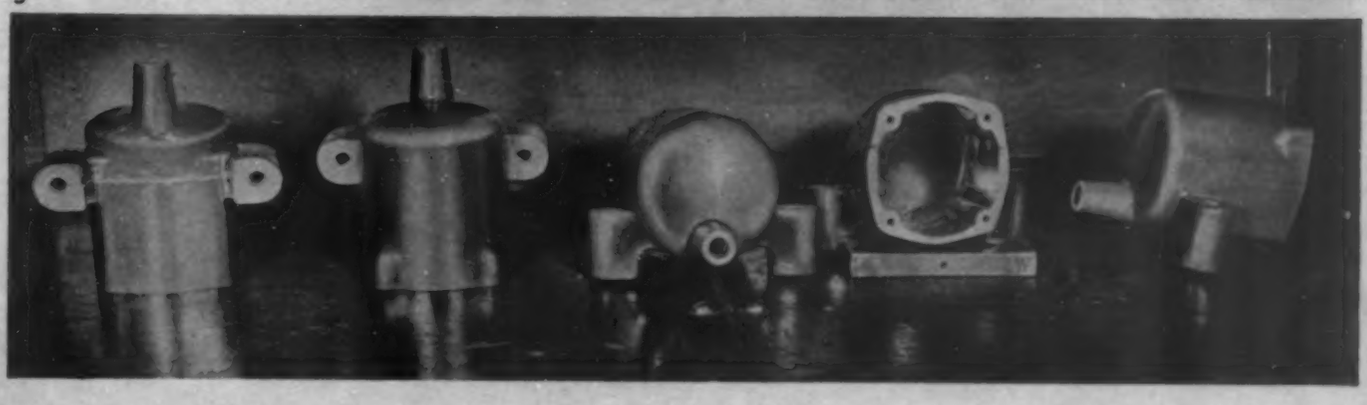

2—Close-up of injection nozzle retracted to give a better view of its construction. 3—Mold in closed position. The lip of the mold is at center front. In the background is part of the electrical control equipment of the indexer. 4—A curved truck coil case is being removed from the continuous injection molding machine. At the right of the operator is a blank station on the rotary indexer. 5—Five views of the truck coil cases cast by the continuous injection process

Orange juice extractor

SQUEEZING 350 oranges a minute, 24 hours a day keeps this machine so busy there is no time to coddle its "hands" to keep them pliable and soft. Yet, these "hands" —7 pairs on each machine—must be ready and alert to grab a fresh half-orange every split second and hold it firmly while a reamer twists inside the shell and removes the juice. The "hands" are half-round or cup shape (Fig. 2), made in two halves so they can flip open and closed as skins are discharged and fresh fruit enters at lightning speed. A pair may be seen at the left in Figure 1.

The efficiency of the "juicer" depends upon the performance of these cups. They not only must grip the fruit firmly and hold it without slippage while the reamer operates inside at 375 r.p.m. to remove the juice, but they also must maintain their shape and resilience in order to hold the fruit closely in contact with the reamer else not all the juice will be removed. In addition they must be flexible enough to handle fruit of varying sizes—no two oranges are exactly alike—and there must be no tendency for the shells to stick to the surfaces of the cups. Except when the machines are shut down for washing and sterilization every 10 or 11 hr., they are busy every minute of the day and night.

For a number of years these cups were made of rubber, but fruit acids and oils from the orange skins caused the rubber to swell and distort until it could no longer grip the fruit. The machine had to be stopped and the cups changed, resulting in costly delays. Some of the rubber cups would last a month, some 3 or 4 months, but they were so badly distorted and thrown out of shape when they were taken from the machine that they were a total loss.

The burden of this replacement was borne by the Brown Citrus Machinery Co., which has been making machines for 14 years and leasing them to fruit packers all over the West and South. As demands for machines increased and installations were made in widely separated areas, the problem of servicing became acute. For a while the company tried synthetic rubber. Synthetic rubber was better than the natural product, but the speed of the machine and the constant clutching of acid fruit caused it to break occasionally. And it could not be repaired. Finally, a large rubber company suggested use of its polyvinyl chloride compound. Practically all trouble disappeared following the adoption of this material which is notably resistant to moisture and mild acids, and remains soft and flexible after a long period of use in the extractor.

"If one of the polyvinyl chloride cups breaks or becomes chipped," said a company official, "it can be repaired satisfactorily with a soldering iron and low heat in a moment's time. We have reclaimed hundreds of these parts after a corner has been broken off—something we can't do with rubber. We use neoprene and other synthetics," he continued, "and they give very good service. However, we like cups made of polyvinyl chloride compound better because this material lasts four or five times as long as rubber and is simple to repair."

Citrus juice packers like the new cups because they help get more out of every orange whirled through the reamers. As soon as a cup loses its shape, even to the least extent, not all the juice is removed. This represents a definite loss. Ideally, a packer's juice extractor should turn out about 150 to 200 gal. an hour, but the top figure can be reached only when the machine operates perfectly all the time. To achieve this production, the great rotary juicers use methyl methacrylate bearings as well as the new plastic cups which permit the last drop to be reamed from every orange with almost no time out for repairs. These plastic bearings, unlike the bronze bearings formerly employed on these extractors, are unaffected by contact with citrus juice and hot steam.

Credit—Material: cups, Koroseal, molded by B. F. Goodrich Co.; bearings, Lucite. Extractor manufactured by Brown Citrus Machinery Co.

PHOTO, COURTESY BROWN CITRUS MACHINERY CO.

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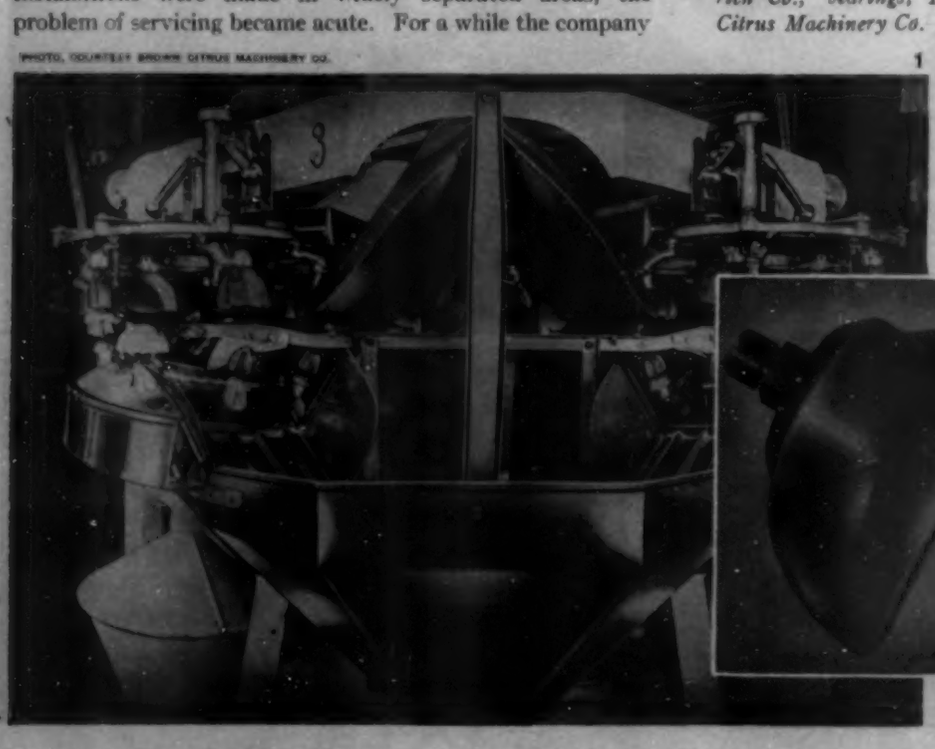

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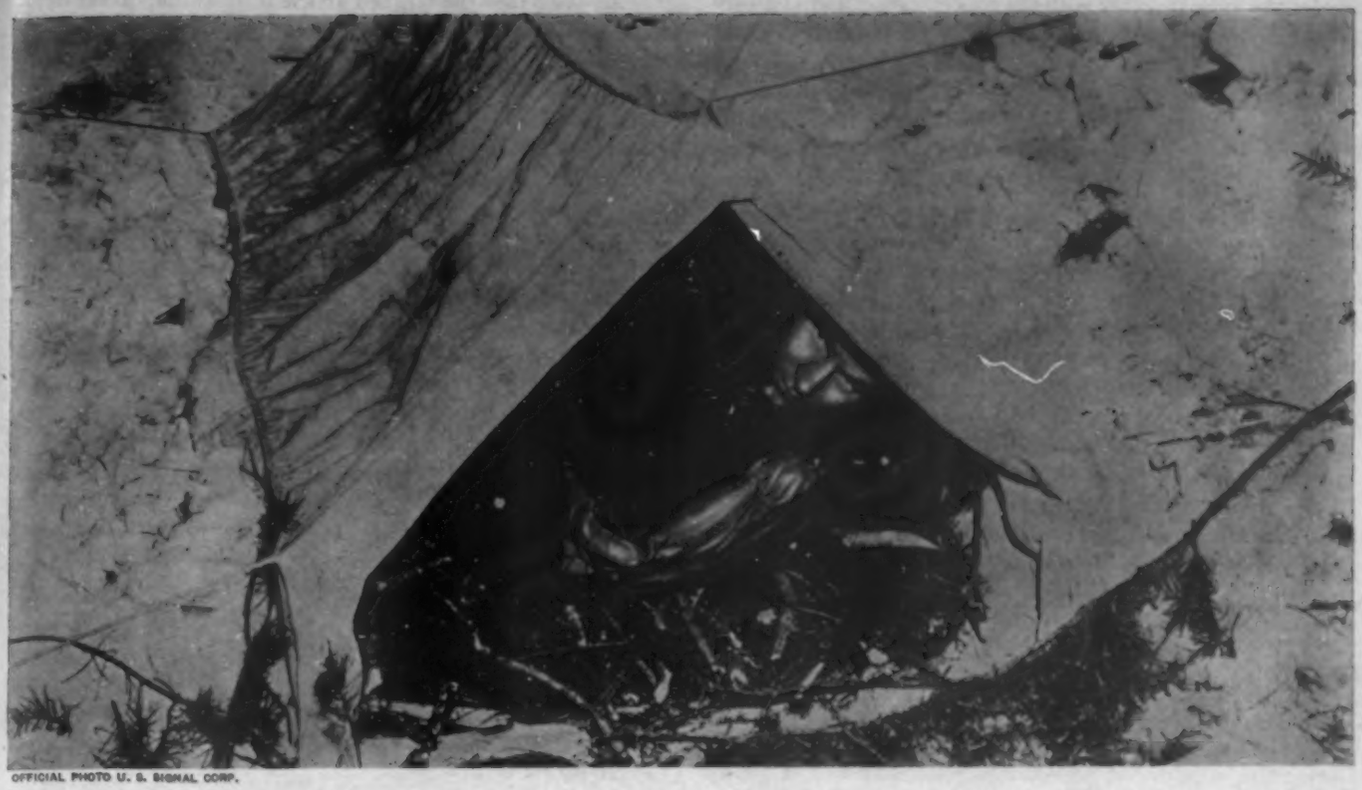
1—Methyl methacrylate bearings and polyvinyl chloride cups are used on this extractor to achieve maximum production. 2—These plastic cups are unaffected by fruit acids



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1—Snow tent of vinyl resin-coated fabric is white on one side and green on the other for camouflage protection

Lacquer-type fabric coatings

by DORMAN McBURNEY*

DURING the middle ages the treatment of woven fabrics with the application of various types of coatings was practiced to realize decorative and protective effects. Today, other fabric treatments result in mold and mildew-proofing, fire and hydrocarbon resistance. Continuous waterproof coatings, simulating the appearance of genuine leather, are being produced with outstanding flex performance, freedom from spewing or sticking at 200° F., and from cracking at −50 to −60° F.

In producing continuous fabric coatings two general types of manufacturing procedure are employed—calendering and spread coating. To a limited extent lamination of preformed film to fabric also has been employed for specialized applications. The discussion in this article is confined to spread-coating in which drying oil coatings and lacquer-type coatings are employed. Rubber coatings and the more recently developed synthetic rubber coatings, which are applied both by calendering and spread-coating methods, are not included in this discussion.[1]

Drying oil coatings are familiar in material known as oilcloth and generally involve use of a treated vegetable oil composition whose "set up" is accomplished by chemical change. This type of coating usually is applied by a spread or dipping method and drying is accomplished in a heating chamber in which the coated fabric is festooned. In general, the conventional drying oil compositions are characterized by poor low temperature behavior both as regards stiffening and tendency to crack, and for the most part they have not adapted themselves to severe military requirements.

Lacquer-type coatings differ from the drying-oil type in that the "set up" of the film results from the evaporation of solvent rather than from any chemical change of the coating composition. Prior to the war the most widely used type of lacquer base was pyroxylin. This coating composition was plasticized with a non-drying vegetable oil, such as castor, and pigmented to give the desired color. While patents describing this general process date back to 1855, it was not until the turn of the century that this industry became commercially established in the United States. More recently the use of pyroxylin has been supplemented by other types of film-forming materials such as ethyl cellulose, cellulose aceto-butyrate and aceto-propionate, methyl methacrylate and polyvinyl butyral and polyvinyl chloride resins.

In practical manufacture the film-forming component is dispersed in a suitable solvent mixture and to the resulting viscous dispersion, suitable pigment and plasticizers are added. This coating composition is applied to the fabric by means of a "doctor knife" which is a metal blade held in a fixed position under which passes the moving fabric. By this means a thin layer of coating is applied from which the solvent is evaporated upon passing into the heating chamber of the coating machine. The amount of coating applied to the fabric is governed by the tension of the fabric passing

* Chemical superintendent, Fabrikold Div., E. I. du Pont de Nemours and Co., Inc.

[1] "Replacements for Rubber Coated Fabrics," MODERN PLASTICS *21*, 89–91 (Nov. 1943).

under the knife together with the concentration and viscosity of the coating composition. By applying a plurality of coats varying from 2 or 3 up to 30 or 40, the desired total weight of coating is realized. In this process the organic solvent evaporates and is recovered by activated carbon or scrubbing methods. After rectification it is reused. This practice contributes both to economic advantage and to conservation of solvents, a very important consideration under present-day conditions. Decorative effects when desired, may be obtained by either roller or press embossing. This frequently is followed by application of contrasting color applied by an additional spread coat or by intaglio printing.

Fabrics of various constructions are employed, ranging from light weight sheetings and drills of intermediate weight to heavy sateens and ducks. For certain military applications fabrics woven from synthetic fibers are coming into general use, particularly fabrics made from such materials as nylon which combines high strength and light weight. Use of a protective coating for these fabrics contributes to greater outdoor durability in affording protection from actinic exposure as well as affording the waterproofness required for many applications.

Properties of coated fabrics

Before the war lacquer-type coatings such as pyroxylin-castor oil compositions were widely used because of their advantage over drying oil coatings in retention of flexibility and superior durability. However, current severe military requirements particularly the low temperature requirement of from −20° F. to −60° F., have largely excluded the standard type of pyroxylin coatings. Other special properties required of coated fabric products for military use involve ability to undergo sterilization and laundering treatments, resistance to penetration of war gases, freedom from sticking at 180° to 200° F., hydrocarbon resistance, freedom from mold and mildew growth, and non-flammability.

Adaptability to practical fabrication demands features in addition to those required of the coated fabrics themselves. For example, freedom from curling of small pieces prior to being sewn into the finished article is an all-important detail in practical garment manufacture. New types of cementing compositions also have been developed for bonding new types of coatings as well as for sealing the needle holes after stitching. In contrast with the older practices of stitching and sealing, new techniques have been developed—for example, bonding two coated surfaces by heat and pressure. An important requisite of double-coated fabrics for this use is a suitable thermoplastic coating on one side and a coating on the opposite side which is free from any tendency to stick to the heat-sealing equipment during the fusing operation. In both cases a high degree of anchorage of the coating to the fabric is required since the strength of the heat-sealed bond depends on the anchorage of the coating to the fabric; and preservation of the outer protective coating during the heat-sealing operation likewise depends upon the proper anchorage of this coating to the fabric. In fact, practically all of these applications involve not only the required physical properties of the coated fabric itself, but also practical adaptability to the manufacturing procedure of fabricators who make the finished article.

Coated fabric products in military use

As examples of some of the new coated fabric products employed for military application the following have been selected as of particular interest.

Army raincoat material.—For this product polyvinyl butyral and polyvinyl chloride resin compositions have been employed for both double- and single-coated products. Requirements involve freedom from sticking at elevated temperature and from cracking at low temperature, as well as good hydrostatic resistance initially and after creasing at low temperature. The material supplied at present has resulted from numerous modifications made as a result of accelerated tests involving conditions of intermittent saturation, high temperature storage and low temperature flexing, and from actual service tests.

Outer shell for sheepskin jackets.—This product is a single-coated drill used as the outer element for sheepskin-lined

2—*This jungle hammock has a waterproof and mildewproof canopy covering of synthetic resin-coated fabric. It also is equipped with a mosquito netting enclosure, a mattress and a sling from which a gun can be suspended during the night*

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OFFICIAL PHOTO, U. S. SIGNAL CORPS

coats. It is subjected to severe flexing in the extremes of weather conditions involving low temperature and sunlight exposure. Formulation of the polyvinyl chloride coating which is employed has involved special consideration of pigment composition and realization of maximum anchorage.

Clothing interliner.—This product, which involves the use of a light weight (1.5 oz. per sq. yd.) rayon taffeta, is used as an intermediate layer between the outer and inner ply of jackets and trousers as a wind and waterproofing element. The impregnating composition employed is a plasticized, non-pigmented polyvinyl chloride composition which results in hydrostatic resistance of 15 to 20 p.s.i. Soft pliability and freedom from rattle also are required as well as freedom from sticking at 180° F. and cracking at −40° F. Because of the extremely light weight of this product and the type of fabric involved, the balance in realizing the desired combination of properties is extremely delicate.

Utility cloth.—This cloth is a double-coated product, blue on one side and yellow on the other, and is carried in aircraft where lightness of weight is essential. It may be employed as a sail or as a means of collecting rain water. When desired as a camouflage in open water it is exposed with the blue side up; if desired as a means of identification to attract overhead planes it is exposed with the yellow side up. Because of use under widely varying climatic conditions—storage in a tightly folded pack in the tropics or handling when wet in an open boat at low temperature—this product is subjected to unusually severe requirements. In view of this fact and because of the desire for minimum weight, special consideration has been given to the choice of fabric and balance of coating properties.

Mountain tent material.—As in the case of utility cloth, this product involves consideration of camouflage. It employs an olive drab coating on one side to blend with foliage and white on the reverse side for use on snow-covered ground. In view of the special consideration given to weight, an extremely light cotton fabric (balloon cloth) has been employed. Quite recently a still lighter nylon twill of greater strength has been found to particularly adapt itself to the requirements of this product. Independent of initial physical properties, an important additional requisite is outdoor durability. To this end the pigmented coating plays an important role in retarding loss in tensile and tearing strength of the fabric upon continued sunlight exposure.

Adhesive tape backing.—Cleanable adhesive tape involves application of a light-weight waterproof coating on the side of the fabric opposite to that on which the adhesive mass is applied. This type of product has been on the market for several years. With the development of cellulose derivative waterproof coatings capable of being sterilized this type of product has been adapted to the small adhesive bandages which are individually sterilized and which constitute an important part of first-aid kits.

Hospital sheeting.—Shortage of rubber has, of course, resulted in restriction of conventional coated fabric hospital sheeting such as was used in the past. With development of specially formulated polyvinyl chloride resin compositions capable of sterilization, a satisfactory hospital sheeting has been developed for military use. This material is capable of undergoing repeated sterilizations without impairment of the coating and in service has proved quite satisfactory.

Jungle hammock canopy.—This is a light weight polyvinyl chloride coated sheeting used in the tropics as a covering for the top canopy, side and end panels of jungle hammocks. In addition to the requisites of hydrostatic resistance, freedom from sticking at elevated temperature, etc., this product involves resistance to mold and mildew growth. In realizing this property both the fabric and the coating are treated with water insoluble fungicides. Accelerated testing in connection with mold growth involves inoculating the coated samples with chaetomium globosum and incubating in moist warm ground for 21 days. Following this there should be no visible mold growth or appreciable loss in tensile strength of the fabric.

Blanket covering.—This product employs a light cotton sheeting coated on one side with a polyvinyl chloride composition. It is sewn to a wool blanket to form a waterproof outer covering for protection of life boat occupants. It also has mold- and mildew-resistant properties as well as resistance to a hydrostatic head of (*Please turn to page 172*)

3—A sleeping bag which has an outer shell of vinyl resin-coated fabric and an inner kapok-filled pad. 4—Equipment on the Flying Fortress life raft includes a sail and utility cover dye bag made from fabric coated with synthetic resin

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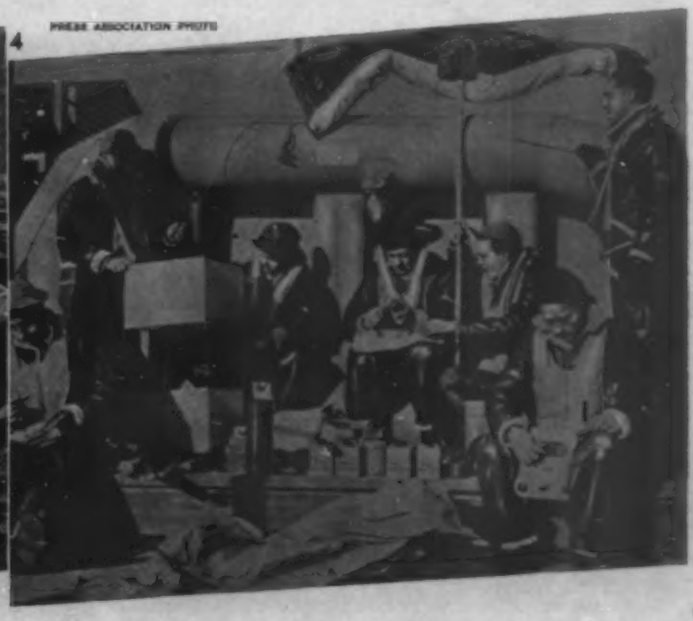
PRESS ASSOCIATION PHOTO



New trends in railroad lighting

by L. SCHEPMOES*

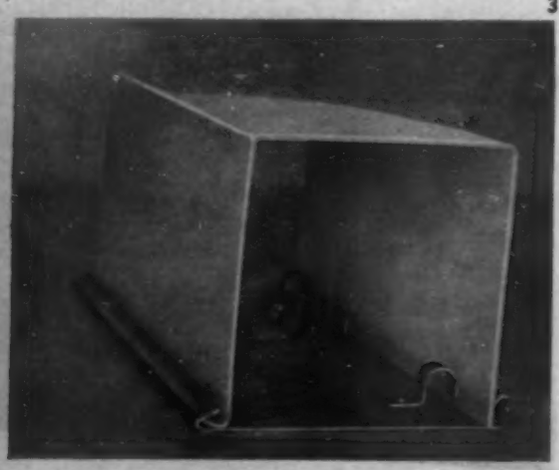
IN the few years before the war started, travelers were given a brief but intriguing glimpse of a new trend in railroad car design—a trend based on the logical premise that railroad travel can be a comfortable and pleasant experience. Mechanical engineers assisted in this development by cushioning cars against annoying shock by improved truck and road beds. Even more evident were contributions made by industrial designers who aimed directly at improving the personal comfort of the railroad riding public. Air conditioning, for example, made cars not only cooler but cleaner. Roomettes and duplex bedrooms brought a new high in privacy and convenience for they included even more convenient facilities than the old sleeping car "compartments." Club cars became truly lounge cars—comfortable and attractive living rooms on wheels. "Little" things such as restful color schemes, which railroad men might have scorned 20 or even 10 years ago, were given deserved attention.

An important factor contributing to this luxurious atmosphere was proper lighting. Lighting fixtures were designed to provide adequate illumination for comfortable eye-saving reading and to fit into the interior decoration of the car just as they have been used in modern homes, stores and public buildings. However, in addition to the usual problems of the lighting engineer—candlepower, shadows and glare—railroad lighting installations must meet certain special requirements: 1) they must be rugged and dependable so that valuable rolling stock will not be tied up for repeated repairs, 2) they must be permanent with a life as long as that expected of the car itself, 3) the installations must be simple and accessible, permitting quick and easy cleaning and maintenance, 4) they must be economical and efficient, requiring a minimum of electric current, and 5) they must meet such other requirements as light weight, ease of installation, safety and freedom from rattling and other annoying noises.

Faced with these requirements, one railroad lighting and heating company has been actively investigating all types of materials for these installations. Early in the game, it started working with plastic shades. The success of these first installations increased the company's enthusiasm for the use of plastics and in 1939 it adopted white translucent methyl methacrylate to meet the requirements for the ideal railway lighting shade. The plastic was tough and could withstand not only hard blows but the flexing caused by the weaving motion of the train. In the aircraft field the material had proved the permanence of its optical properties and its freedom from shrinkage and warpage and other dimensional changes.

* Manager, Lighting Fixture Dept., Safety Car Heating and Lighting Co., Inc.

1—For railroad use, continuous fluorescent lighting fixtures are designed with shades of methyl methacrylate. 2—Side wall fixture has combined methacrylate and sheet metal shade, flexibly compressed for removal from supporting frame. 3—Shade with metal applique removed



It was lightweight, shatterproof and rattleproof. The only possible disadvantage of this thermoplastic material lay in the fact that it might soften and deform if the temperature of the fixture exceeded 160° F. This objection was circumvented by the use of fluorescent lamps which also ensured an economical and efficient light source. The white translucent plastic is available in 5 opacities. One of the lowest (122–50) was chosen because it offered the highest direct-light transmission (82 percent in .060 in. thickness) and at the same time effectively diffused the light source.

In many of these railcar installations an ingeniously simple method of mounting is used which depends for its success on the flexibility of the material.[1] The shades are formed with a slight outward flange along the edges. The piece can be flexed so that the shade is snapped into two paralleled channels. This installation, which is shown in Fig. 2, permits quick and easy removal for cleaning or replacement of the lamps. It also has proved extremely versatile. For long troughs running the length of the car, 24 to 48-in. lengths of shade have been used separated by rigid, reinforcing spacers molded from white translucent methyl methacrylate resin. Modifications of this arrangement include troughs which zig-zag back and forth across the ceiling of the car and those which might run intermittently along the car ceiling, valence or side wall. We have used snap-in methacrylate shades to cover fluorescent fixtures incorporated in luggage racks.

At first adequate lighting for foyers and observation cars where the lighting trough might have to make a sharp curve, presented something of a problem. It was found that by overlapping ends of the fluorescent lamps continuous lighting for such cars could be provided. The possibility of forming methacrylate into compound 3-dimensional curves was particularly appreciated at this time.

The trend toward better lighting which began before the war is only a start. Railroad men are well aware that they will have to face increasing competition from buses and airlines as well as from private cars and possibly private planes. They are preparing to meet this competition with the same kind of product improvements progressive manufacturers also are planning. The product happens to be railroad travel, but by thinking of the comfort, safety and convenience of the consumer, they are making a sound approach to the problem.

Credits—Material: Plexiglas. Lighting fixtures manufactured by the Safety Car Heating and Lighting Co., Inc.

[1] This method of installation as used in lighting fixtures is the subject of letters patent held by the Safety Car Heating and Lighting Co., Inc.

4

4—Continuous zig-zag fluorescent ceiling lights with plastic shades, designed by Henry Dreyfus for a lounge car on the New York Central

5

5—Fluorescent valence lights and ceiling lights on a N.Y., N.H. & H. dining car have shades of the same plastic. Lurelle Guild, designer

Product Development

Military signal lights

To facilitate inter-aircraft communications or signaling between plane and ground personnel the Armed Forces have adopted two types of signal light—the K-3, a stationary unit, and the K-2, a hand model. To a limited extent both lamps can be used for communications between ground vehicles. While the K-3 is affixed to one spot by a metal bracket, this attachment has a swivel arrangement which allows considerable latitude in the movement of the lamp and consequently in the direction of the beam of light. The 150,000 candle power signals sent out by these units may be observed for several miles under favorable atmospheric conditions and are switched on and off by finger pressure on a trigger.

In both units the holder and handle are molded of phenolic resin as integral parts. The three other phenolic parts that constitute the final assembly are the handle cover, the trigger and the switch contact retainer. So that signals of varying color may be sent out, each unit is packed in its carrying case with red, green and amber polystyrene filters. A 10 percent transmitting filter of the same material also is supplied, enabling a dim light to be used for short-range operations. All of these disks are molded with holes for the attaching of clips. These clasps hook firmly upon the rounded edge of the lamp housing and hold the filters in position.

Credits—Housing: Bakelite. Molded by Grimes Manufacturing Co. Filters: Bakelite polystyrene. Molded by J. H. Shepherd & Sons. Signal lights produced for the Armed Forces

Canadian insignia

Spurred by a shortage of metals, the Canadian government has commissioned a number of companies to manufacture plastics insignia and buttons for such service groups as the Canadian Garrison Battalion, Canadian Paratroopers, Royal Canadian Air Force, Royal Canadian Ordnance Corps, Royal Canadian Army Service Corps and Canadian Navy.

Cellulose acetate is the material being used for the injection molding of most of the insignia. A shank molded on the reverse of each badge as an integral part of the insignia provides a suitable base for a fastener. Some companies use a short plastic rod as a catch. One end of this rod has a head to prevent it from going all the way through the shank hole while the other end is split to form a spring. Other badges are fastened with metal safety-pin type clasps.

In the case of plastic buttons, colors to fit the requirements are included in the molding powder. The metal shanks by which buttons are sewn on the uniforms, are inserted in the lower half of the mold. Navy buttons are molded of urea-formaldehyde.

Chrome plating masks

Contributing to the speed with which airplanes are coming from the production lines are plastic plating masks used to protect sections of aircraft parts during the chrome plating operation. In the case of landing gear mechanism the masks

may cover the threaded ends of the pistons where plating is not required. These polyvinylidene chloride masks are understood to be the largest injection molded parts of this type so far undertaken. The molding cycle varies from 35 sec. on the small mask to 70 sec. on the larger plastic piece. Reading from left to right, the masks shown in the accompanying illustration (upper right) weigh 23, 18 and 35 ounces.

Plastic masks have been adopted as the most satisfactory type of guard since tests indicated that they withstand all cleaners, acids and the plating bath without signs of deterioration and that they do not "tree."

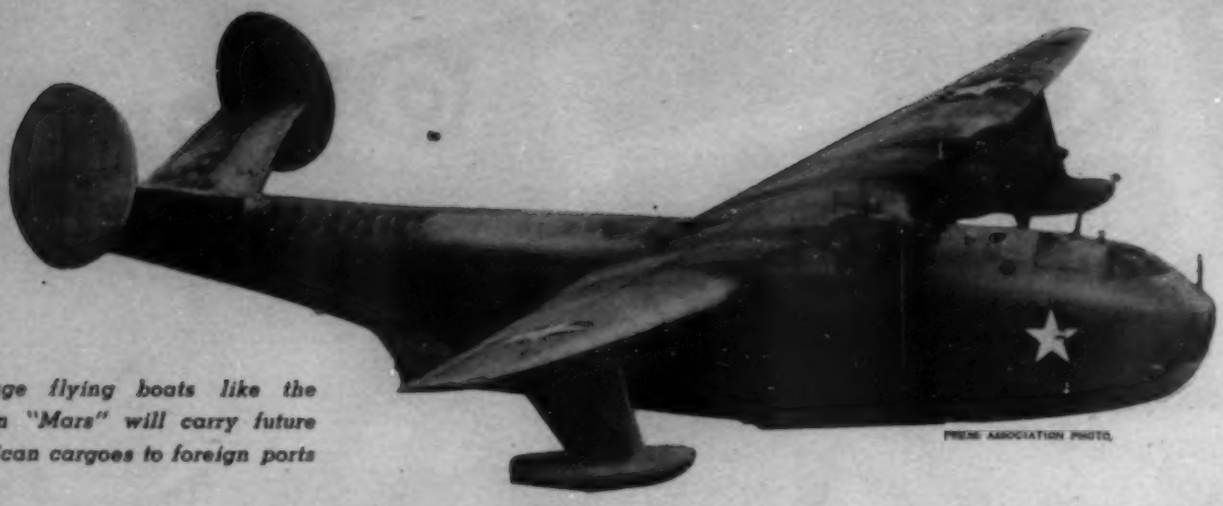
Credits—Material: Saran. Molded by St. Louis Plastic Moulding Co., for Wayne Div., Bendix Aviation Corp.

Inspection flashlight

Before any of our fighting planes or bombers take to the air they must be examined carefully to insure that all equipment is in order. This maintenance work includes inspection of electrical circuits, gasoline tank connections and wiring throughout the fuselage and wings. The interior of all cylinders must be examined for dirt that later might clog the engines. In order to place a direct beam of light very close to these "out of the way" points of inspection and inside the motors, the Army Air Forces has adopted this special-type flashlight with the light bulb housed at the end of a flexible metal tubing.

The three main parts of this flashlight—the body, bottom cap and top—are molded of cellulose acetate butyrate in a 3-cavity die. All threads are molded-in through the use of two sets of threaded cores, a procedure that eliminates all unscrewing mechanism in the mold. Also included in the molding operation are the switch slot, contact rivet and hole, and the lettering required by the Army Air Forces.

Credits—Material: Tenite II. Molded by Standard Molding Corp., for Army Air Corps



PRESS ASSOCIATION PHOTO

1—Huge flying boats like the Martin "Mars" will carry future American cargoes to foreign ports

The future of plastics in aviation

by W. WARD JACKSON*

DURING the past few months considerable thought has been given to the question of what lies ahead for American industry. This consideration on the part of engineer and layman alike has resulted in some comment on the fact that we are thinking too much of "business as usual" and not enough of the business of winning the war. Those of us who have been close to the pulse of both industry and the war effort can truthfully state that this is not the case. We do hear terms such as "postwar" and "peacetime planning" used from time to time as if they were totally new ideas, or new phenomena that overnight might be expected to precipitate us into a new world of miraculous achievement. Actually, "postwar planning" is a new phrase that has been coined to describe an old and sound business practice—plain commonsense planning.

Industry's first mission is to win total victory over our enemies, but we have a further duty—that of winning the peace. Upon industry's future plans depends the future economic, political and social wellbeing of our country.

The end of this conflict will find us with 500,000 trained pilots and 2,000,000 aircraft mechanics. These flyers will want to continue to fly, but a large percentage will be unable to afford aircraft unless we do something about the low-cost plane and economical facilities for handling such aircraft. After the last war there was tremendous interest in flying. However, it was an expensive pastime and until 1939 little private flying was done. This must not happen again.

During the early stages of the present war it became apparent that the aircraft and the plastics industries, working together, were destined to form one of our most potent weapons. It is fitting, therefore, that consideration be given to their future association. Let us consider some of the steps which have led to the use of plastics in aircraft, their possibilities and limitations, and the part plastics should play in the future of the aircraft industry.

* Aircraft consultant, Plastics Section, Chemicals Div., War Production Board.

Growth of plastics in aircraft

On December 7, when Japan attacked, the United States was faced with an extremely serious situation. We found ourselves cut off from sources of supply of certain materials essential to the war effort, and critically short of others. Our supply of rubber was completely cut off and our aluminum facilities were taxed beyond their capacity. We soon realized that our aircraft must be lighter and faster and that we must make the best of what materials we had available. Plastics

2—The Douglas C-54 is a forerunner of the passenger ships that will fly the country's commercial air routes. *3—For the man who likes to pilot himself, there will be private planes like the Piper Cub*

PRESS ASSOCIATION PHOTO 2

PHOTO, COURTESY PIPER AIRCRAFT CORP. 3

had met with some success in the automotive field during the previous few years, and had aroused considerable interest on the part of that industry. Therefore, the aircraft industry with an immediate requirement for materials to relieve the situation in rubber and aluminum, turned its attention to the light weight and workability of plastics. When plastics were called upon to fill this need they responded immediately and the industry mushroomed overnight. We needed results in a hurry, and there was little time for extensive test data. It was only natural that some mistakes were made in the applications of plastics to aircraft.

The aircraft industry, feeling the pinch of shortages, plunged headlong into plastics without, in many cases, acquiring a sound, fundamental knowledge of the materials with which they must work and, furthermore, without the technical staff to carry out such an enterprise. Some of the more forward-looking of the companies established plastics departments, but mistakes were made and plastics suffered. We had little to work with in the early days in the way of concrete information. The aircraft men were accustomed to working in metals and tried to apply metal techniques to plastics; on the other hand, the plastics men did not know what to expect or to shoot at in the way of over-all characteristics for aircraft application. It soon became apparent that there must be a correlation of the problems of the aircraft industry and those of the plastics industry. They had to be studied together with a resultant exchange of data and requirements.

With the realization of the problems at hand, both the aircraft and the plastics industries were quick to realize the possibilities of plastics in many aircraft applications. Overnight plastics became the cure-all for manpower, weight and procurement problems. The demands, based on sound engineering, for many plastics indispensable to the operation of aircraft increased to such an extent that the available facilities were taxed beyond their limit. In many cases, the substitution of plastics for other critical materials was made without careful consideration of the supply problem. This hit-and-miss policy soon proved its unsound basis and actually solved its own problems by quickly exhausting the supply of raw materials.

Although an effort was made to expand facilities needed for the production of plastics necessary to the war effort, and at the same time to discontinue the substitution of plastics for metal where such substitution was inadvisable because certain values were lacking, the situation became so serious that the WPB was forced to place most plastics under allocation to insure their availability for the really essential end uses. The allocation of materials was probably most opportune for the plastics industry for it provided the argument for extensive test data and showed the need for real results rather than guesswork. It soon became necessary to clarify the position of plastics with respect to their use as an alternative for metals. The policy followed was simply to state the facts

PHOTO, COURTESY LOCKHEED AIRCRAFT CORP.

4

5

PHOTO, COURTESY P. V. ENGINEERING FORUM

4—The mock-up of the Lockheed "Constellation" indicates that the postwar air traveler will ride in luxury. 5—Commuters who must take off from their lawns and land on rooftops will find small helicopters the best medium

about a given plastic and to show the necessity for sound engineering in its application.

The manufacturer who considered the use of plastics in place of metal was asked to consider four points, which provided him with a quick method of interpreting the end uses involved. These points were:

1. If a prospective use for plastic materials is indispensable to the operation of the aircraft, the plastic will be made available in the required quantities.
2. If the use of plastic materials in aircraft parts results in a material improvement in the performance characteristics of the plane or equipment, we believe sufficient material will be made available, dependent upon the supply picture at the time of the request.
3. In those instances where sound engineering indicates that plastics are fitted for any given application and where their use will result in a substantial saving of weight of the aircraft or in man-hours required for its fabrication, it is probable that the plastic materials can be made available.
4. If a prospective application constitutes a direct substitution for metal without any other apparent advantage, we do not believe it practicable to consider the use of plastics since the total availability in most cases will not be sufficient to cover applications of this nature.

We are over the crest of these difficulties and our unsound applications have been reduced to a minimum. The experience we have gained in private laboratories and in those under jurisdiction of the Armed Services has corrected many of these errors and has in still more cases provided data which indicated immediately one very important fact: *plastics are prime materials and must not be considered as substitutes.* This was a point which some of the more experienced in the industry had been preaching with minor success for some time. Actually, it took the first few years of the war to bring out the true value of plastic materials.

Limitations and possibilities

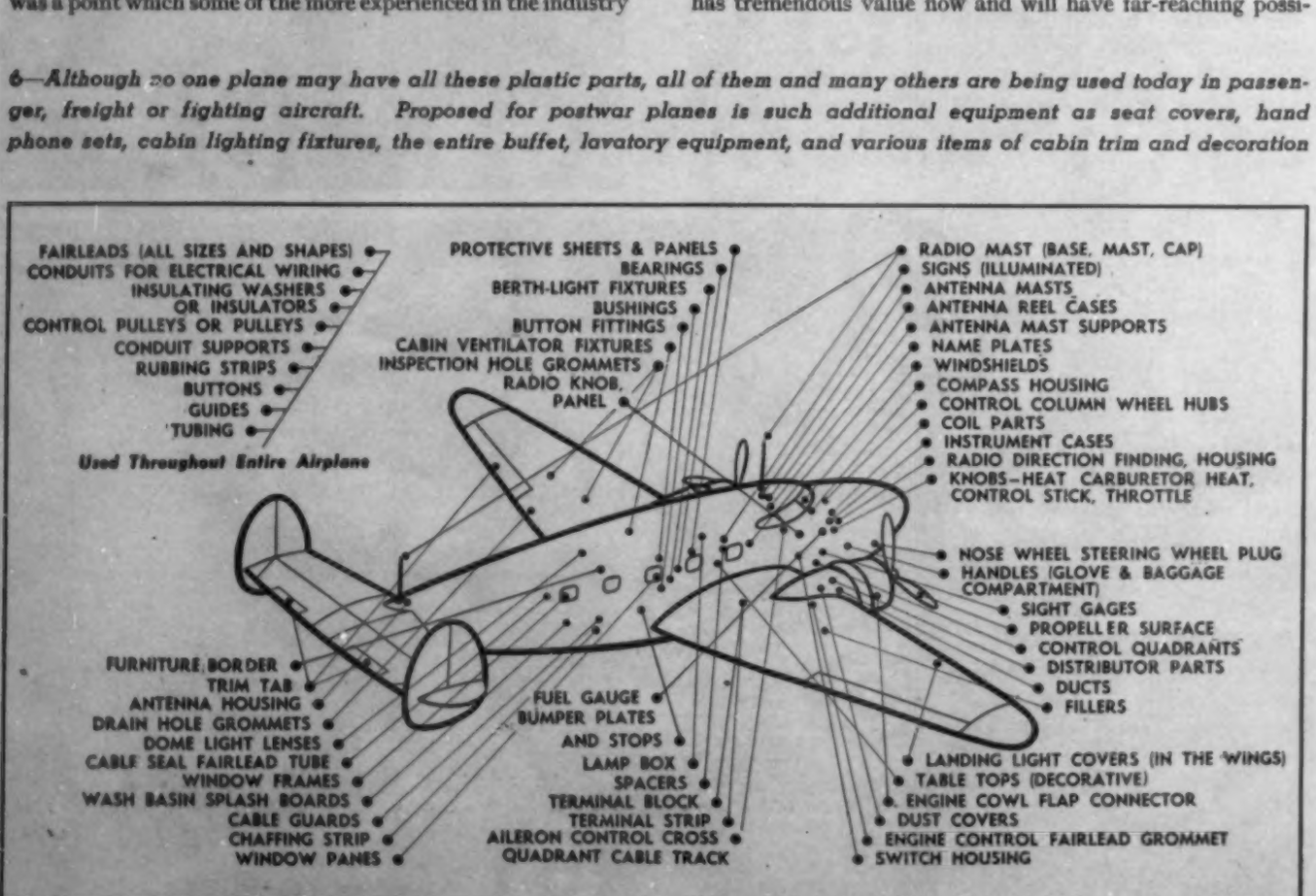
Out of the wealth of data compiled during the last few years has come the realization that plastics have a definite place in the aircraft industry now and in the future. In consideration of this fact, it is well to keep the following points in mind:

1. Plastics are not cure-alls for difficulties in procurement, design or material.
2. The maximum value of plastics will be realized when plans for their use are considered in the early stages of design. Here their outstanding characteristics—namely, ease of fabrication, light weight, high unit strength, fatigue resistance and others—may be used to best advantage.
3. Plastics are much more versatile than metals but their characteristics must be used to advantage and their specific limitations considered.
4. The use of plastics will in many cases provide a lighter structure, one which is stronger and easier to fabricate and a unit which will probably prove cheaper from a production standpoint.

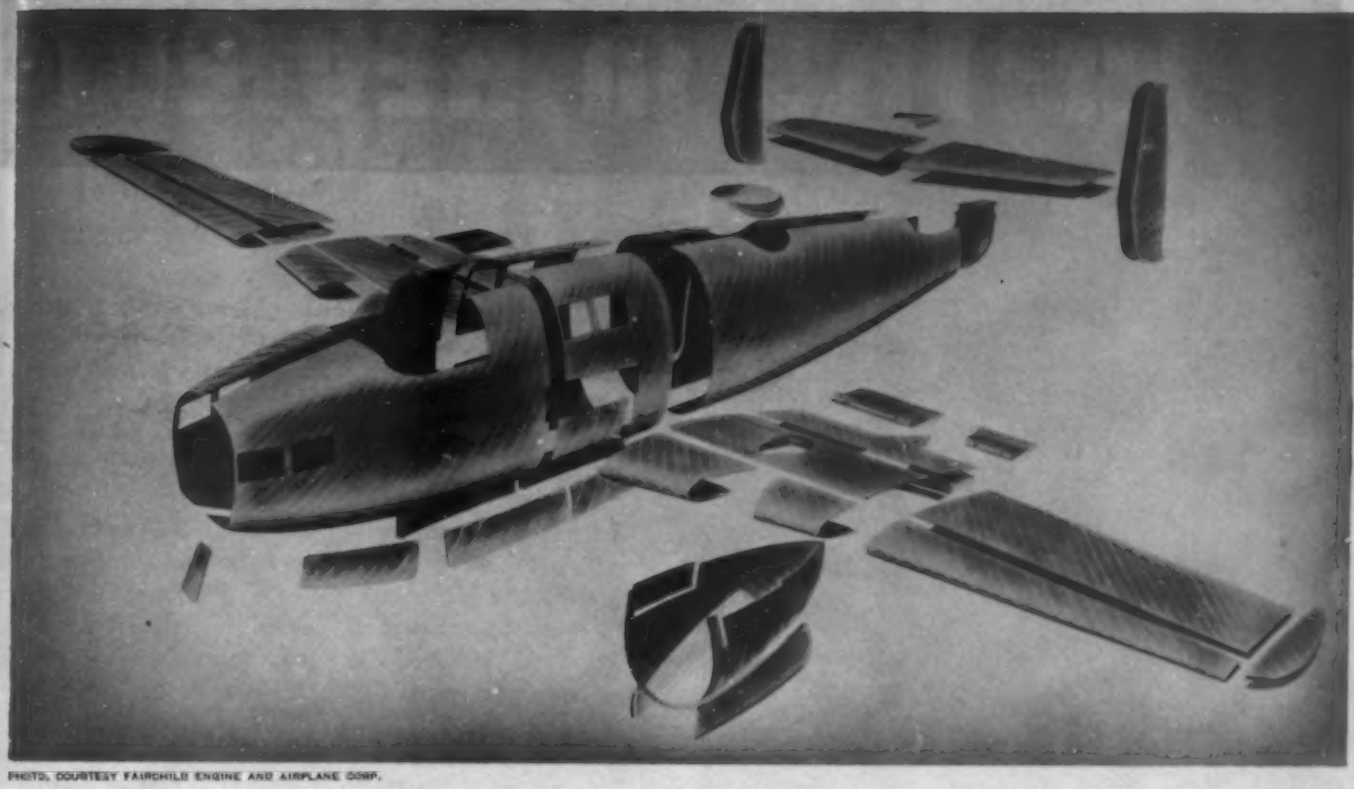
The future of the plastics industry can in some measure be anticipated by looking at its record of achievement to date. Not only have many new plastics been discovered but properties of those on the market have been improved. Hundreds of parts now used on aircraft are made of plastic materials which were unheard of just a few years ago.

The saving in weight alone effected by the use of plastics has tremendous value now and will have far-reaching possi-

6—Although no one plane may have all these plastic parts, all of them and many others are being used today in passenger, freight or fighting aircraft. Proposed for postwar planes is such additional equipment as seat covers, hand phone sets, cabin lighting fixtures, the entire buffet, lavatory equipment, and various items of cabin trim and decoration



CHART, COURTESY E. I. DU PONT DE NEMOURS & CO., INC.



PHOTO, COURTESY FAIRCHILD ENGINE AND AIRPLANE CORP.

7—Exploded view of the Fairchild "Gunner" shows the parts of that plane molded of plastic-plywood. The application of radio high frequency to the gluing of plywood will make possible highly stressed, thick sections for postwar planes

bilities in the airplane of the future. We find that we can cut manpower requirements way down by using the fast production cycles of injection molding. We find that the planes can be made to fly higher with plastic insulation and electrical parts. We find that tools, jigs and dies can be produced faster, cheaper and lighter by the use of plastics. We find that molding and forming costs can be cut by the use of thermosetting copolymers. We find expensive and tedious riveting methods reduced to a minimum by the use of plastic welding. We find high frequency heating in conjunction with the use of plastics further cuts down the manpower cost and time of operation, particularly in the fabrication of plywood parts. We further find that the average airplane of today uses hundreds of plastic parts, each having a definite function and each doing its job well.

In many cases the use of plastics for military aircraft has demonstrated their value in combination with other materials. This does not show weakness in the characteristics of the plastic materials but rather demonstrates their ability to combine with other materials such as wood, metal, oils, paper and glass. Such combinations—a foretaste of what to expect in the future—bring out the good properties of each material in such a way that each enhances the value of the other. The plane of tomorrow will not be an all-plastic plane but a combination of plastics, metal and wood.

The road is not short nor is it easy. We have really just begun to use plastics in aircraft and there is still much to be done. By bringing the problems of the aircraft designer and those of the plastics engineer together and making them one, we can unquestionably come out with the right answers. This can be accomplished only by realizing that problems exist.

Consideration must be given to the setting up of a group to correlate the aircraft and plastics industries. To this group, whether it be industrial- or Government-sponsored, can be channeled the wealth of experience gained during the past few years, thus bringing research and production together.

Many small groups already exist in both fields—plastics societies and aircraft organizations—but there must be a postwar group to synthesize the requirements and problems of both industries. We need the means for keeping civilian flying within the reach of the average man and his family, and by making use of the sound characteristics of plastic materials, the plastics industry can play an important part in the realization of low-cost aircraft. Let us think, therefore, about this problem. Our civilian aircraft will be one of our most potent peacetime developments and we must do everything possible to further its advance.

Outlook for the future

What will the civilian plane look like after the war? Where will it be used? What about the new passenger and cargo planes? Where do plastics fit into this picture? These and many other questions pass through our minds as we endeavor to visualize the future. Here are some of the answers.

It is difficult to give in any detail a picture of the future civilian airplane without divulging industrial secrets. However, generally speaking, civilian aircraft will be divided into two types, those of conventional design with certain rather revolutionary changes, and rotary wing or helicopter types. Both groups will be designed for appearance and safety of operation and can be compared in many ways with the low-cost automobile of today. The public will be served by two-, three- and four-seaters with dual controls having a range of about 600 miles. Just as we had a market for fast, expensive motor cars, so we will find a market for the higher powered and faster types of aircraft. Many of the men who have flown warplanes will not be satisfied with a speed of 120 to 150 miles per hour. Where their financial circumstances will permit, they will be in the market for a faster type of aircraft, one with greater maneuverability (*Please turn to page 174*)

PLASTICS in REVIEW

1

1 This Woodwin water-tight lampholder is molded of a cold molded material in a single-cavity die by Plastic Molding Corp. Molded at a temperature of approximately 70° F., about 2000 pieces are produced during an 8-hour shift. This socket is a product of C. D. Wood Electric Co., Inc.

2 Today operators of steam and Diesel engines have no time to devote to the polishing of metal accessories and nameplates. This nameplate which is injection molded of Tenite by Remler Co., Ltd., for F. L. Mitchell Co., will maintain its attractive appearance without constant attention

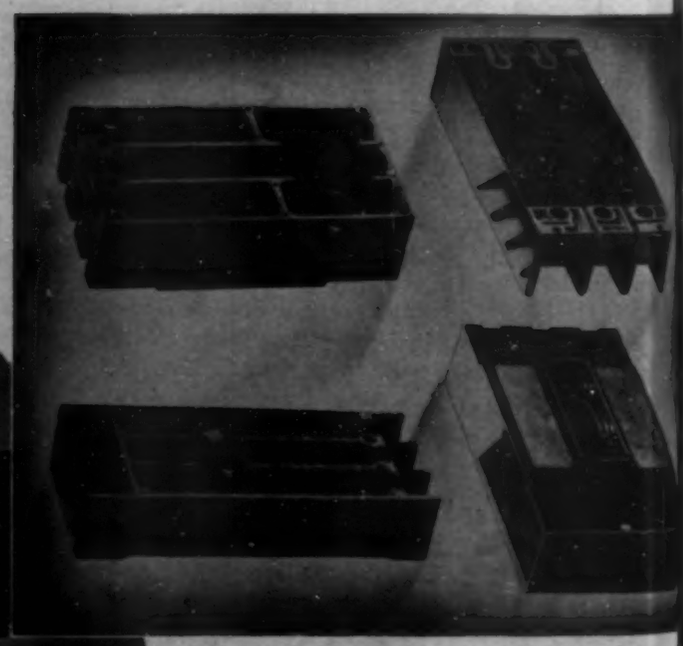
2

3 This double-handle grip for an airplane crank, known to the trade as an inertia starter handle, is extruded of Lumarith by Whiteford Plastics Co. It was through the ingenuity of a rubber and plastics engineer of Eclipse Aviation Div., Bendix Aviation Corp., that this plastic piece with its deeply grooved outer gripping surface was made possible

4 This circuit breaker base and cover are molded of Resinox by American Insulator Corp., for Westinghouse Electric & Mfg. Co. Similar parts also are molded of Bakelite and Westinghouse phenolic compositions

5 The 20-in. propellor blade of this fly chaser fan that is used over doorways in chicken coops, stables and restaurants, is molded of Bakelite linter

3



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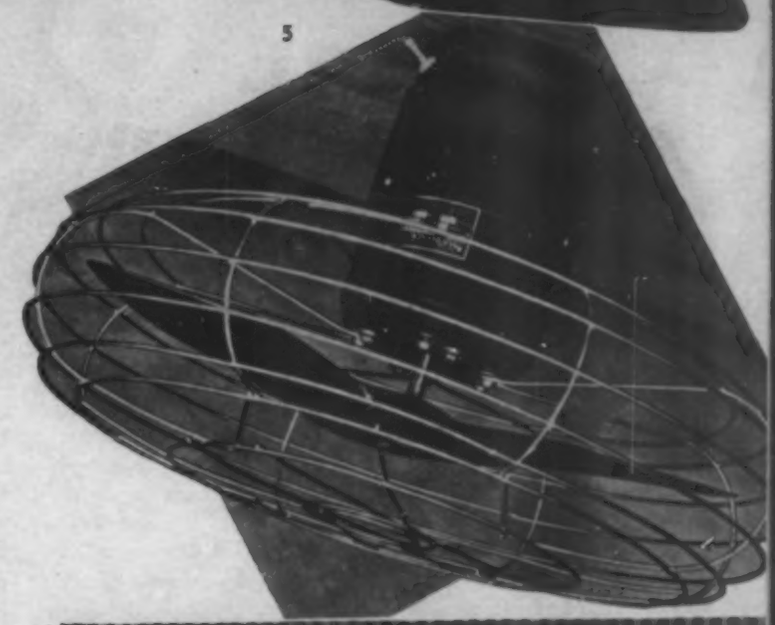
impact phenolic material by Imperial Molded Products for Reynolds Electric Co. The propellers are designed to provide an air barrier through which flys and insects cannot pass

5



6 The Vacutex, a device for personal use in removing blackheads, consists essentially of a barrel with a close fitting plunger, both parts molded of Fibestos by H. Jameson. The point of the barrel is applied to the skin and the plunger pulled out by means of finger grips. The resultant vacuum plus the pressure of the tip quickly and painlessly removes the blackhead

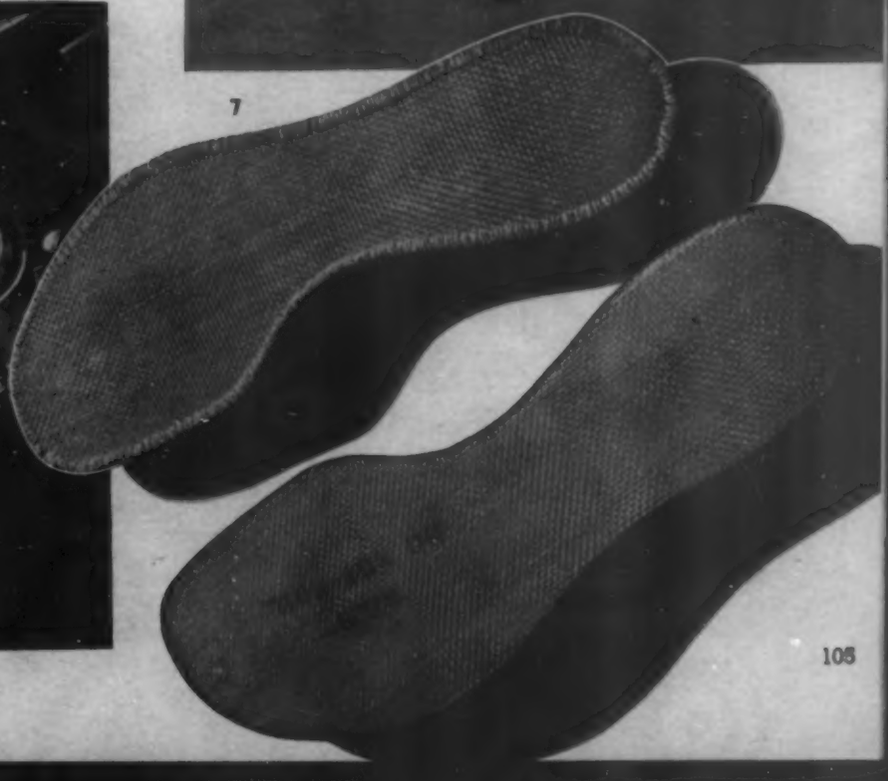
7 These Saran screen innersoles which were developed recently by the Quartermaster Corps, are being used in jungle boots and other military footwear. Made of several layers of Saran screen stitched or welded together at the edges, the soles tend to ventilate the bottom of the foot—a characteristic expected to aid in the control of fungus foot infections prevalent in humid climates

6

8 In these plastic lightning arresters used by the Signal Corps and other branches of the armed forces, small neon lights are employed which flash on during an electric storm when a satisfactory connection is made between aerial and ground. So that the glow will be clearly visible, transparent Tenite arrester housings, molded by Sterling Plastics Co., for L. S. Brach Mfg. Co., have been adopted

8

7



SABOTAGING THE SABOTEUR

OVERFLOWING automobiles careen into the parking lot, crowded buses brake to a stop before the gate, pedestrians dash the last few yards to the entrance. A shift is changing at one of our war plants. With identification cards extended, the workers throng past the guards. A glance at the photograph, a glance at the owner's face, and the guard admits another employee for his 8- or 10-hour stint. Sometimes there is a quick word of greeting or a friendly exchange of nods, but for the most part the guards depend upon the proffered cards for identification. The working force in most industries is too large and the turnover too great for the man at the gate to recognize the majority of those who hurry past him.

With the safety of our most vital war zones and production centers dependent upon these identification cards and badges, the Air Plant Protection Branch at Wright Field recently took steps to insure that the passes are used only by those to whom they are issued and that they are impossible of duplication. These new tamperproof passes consist of cards bearing statistical information and photographs, sealed between double layers of cellulose acetate which have been coated with a liquid adhesive. Attempts

1—The first step in the preparation of forgery-proof identification cards is the insertion of passes, 2 at a time, between transparent sheets of special cellulose acetate, and the placing of the badges, 4 at a time, on a sheet of colored cellulose acetate which then is covered with a transparent sheet of the special material. 2—Several sandwiches of cellulose acetate with their fillers of paper are placed between polished steel plates. 3—The steel plates next are set between the jaws of a press

ALL PHOTOS, COURTESY MONSANTO CHEMICAL CO.

1

2

3

to rip one of these identification sheets apart will succeed only in splitting the paper into layers rather than in loosening the plastic. Such tampering will immediately catch the eye of the guards ever on the lookout for saboteurs.

As a further protection against enemy agents, invisible identification marks are applied to the cellulose acetate sheets. Since these ink markings are visible only under certain rays, even the employees do not know of their existence. Periodically when the passes are to be inspected, employees thrust their hands, holding the cards, through a hole in a partition. Beyond the wall, away from the workers' eyes, an inspector shines the special ray upon the passes, thus illuminating the design impregnated with the plastic. If the original photographs or signatures have been cut out and others substituted, breaks in the lines of the design will be evident.

In making these tamperproof passes for Wright Field, the identification card is prepared as in the past with full statistical information and a photograph. A picture and identifying number are assembled for the badge. The passes then are inserted, 2 at a time, between transparent sheets of the specially marked cellulose acetate. The badges are placed, 4 at a time, on sheets of colored cellulose acetate and covered with transparent sheets of the special plastic. This preparatory operation can be seen in Fig. 1. The supporting sheets for the badges come in 8 bright colors easily recognized at 150 feet. Since each area within the field has a special color assigned to it, guards can recognize quickly an employee who has strayed beyond the boundaries of his section.

The sandwiches of cellulose acetate with their paper fillers bearing the passes next are slipped between a pair of polished steel plates (Fig. 2). A thin sheet of metal is placed between each plastic-paper sandwich to divide it from its neighbor. The steel plates containing the passes or badges are inserted in the flat, heated jaws of a small press. When the press closes, heat and pressure fuse the sheets of cellulose acetate into one tightly welded piece. Upon the opening of the press a few seconds later the hot plates are transferred with special clamps (Fig. 3) to the cold lower jaws of the press where pressure prevents the sandwich from warping as it cools. While this cooling operation is in progress a second set of plates is placed in the upper section of the press to be fused by heat and pressure. Thus an uninterrupted flow of badges and passes can be maintained.

Upon emerging from the press the identification cards and badges are stamped out in their final shape by a machine developed especially for the job. In Fig. 4 the picture badges are being cut to size after the original sheet has been cut in half. By watching the mirror attached to the back of the blanking machine the operator can see when the sheet is properly aligned with the dies. As a final step badges for men are attached to leather tabs with metal grommets (Fig. 5). Badges for women which appear in the foreground of Fig. 5 are strung on a ribbon.

In addition to being supplied to all Wright Field employees, these new forgery-proof identification passes are used by the Air Service Command at all Army Air Force fields and supply depots. The Coast Guard also is employing the system on cards issued to residents of restricted areas along both coasts. Thus, one by one, the possible loopholes for enemy spies and saboteurs are being plugged.

Credits—Material: Fibestos. Process developed by Air Plant Protection Branch at Wright Field. Equipment manufactured by Glassoloid Manufacturing Co.

4—When the sheets of 4 badges emerge from the press after heat and pressure have fused the sheets of cellulose acetate into a tightly welded piece, they are cut in half, then stamped out in their final shape by a specially designed blanking machine operated by a foot treadle and exerting a pressure of about one ton. A mirror arrangement shows the operator when he has the sheet properly aligned with the dies. 5—Men's badges are attached to leather tabs with small metal grommets

4

5

Remote reading compass for aircraft

ALL PHOTOS COURTESY ECLIPSE-PIONEER DIV., BENDIX AVIATION CORP.

1

OF what use is a machine gun or bomb sight tucked away in a remote corner of an airplane? These and certain other airplane accessories require location at crew stations for effective operation. But there are a multitude of other instruments essential to the plane's operation that have positional requirements no less exacting even though they are installed out of sight. In this group is the sensitive unit of the remote indicating compass system. For accurate directional guidance, a sensitive compass element must be located, not with particular regard to the point of observation, but at a place as free from local magnetic disturbances as possible. This results, in present-day fighter aircraft installations, in placing the unit containing the sensitive element, away from engines, armament, turrets or armor plate. And because of this remote position, a visual compass indicator must be provided at several observation points.

After considerable experimentation with various remote reading compasses, one airplane instrument manufacturer evolved the "Magnesyn" system comprising 2 units. The transmitter portion contains the compass or "pick-up" element, while the second unit, the compass indicator, includes the reciprocal receiving elements, the dial and the indicating pointer. As stated previously, several indicators may be utilized with one transmitter. The only movable parts in the entire system are the compass float in the transmitter, and the rotor with attached pointer in the receiver.

The original design of the transmitter unit specified that the housing be made of cast aluminum. However, with aluminum on the critical list of essential materials, attention was given to the possibilities of utilizing a molded plastic case. The phenolic transmitter housing (Fig. 2) now being used in the remote reading compass (*Please turn to page 172*)

1—The housing of the remote reading compass consists of 5 molded phenolic parts. The 3 large pieces are run off in single-cavity dies, the webbed ring in a 4-cavity mold and the other ring in a 7-cavity die. 2—Completely assembled case for the transmitting unit of the compass. 3—This die is used for molding the base of the housing

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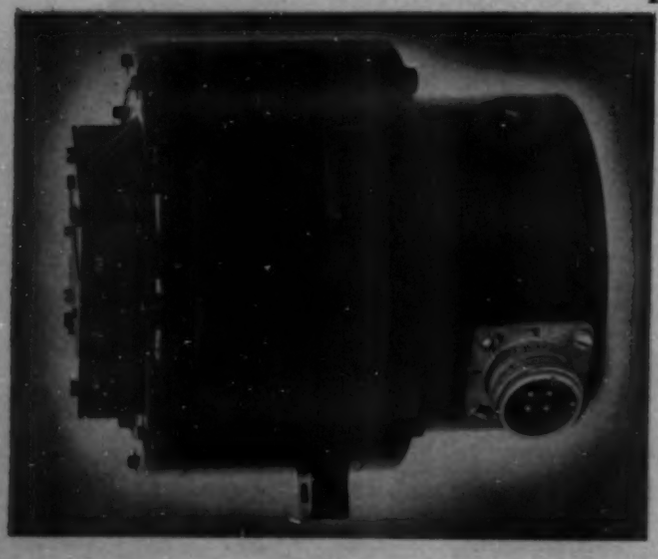

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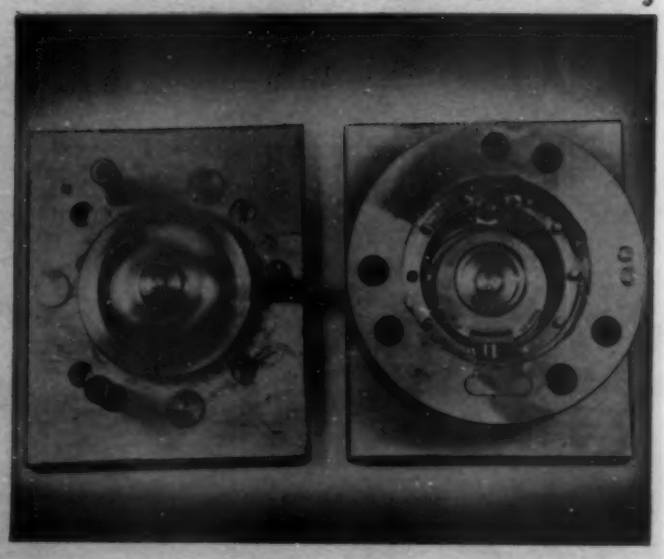


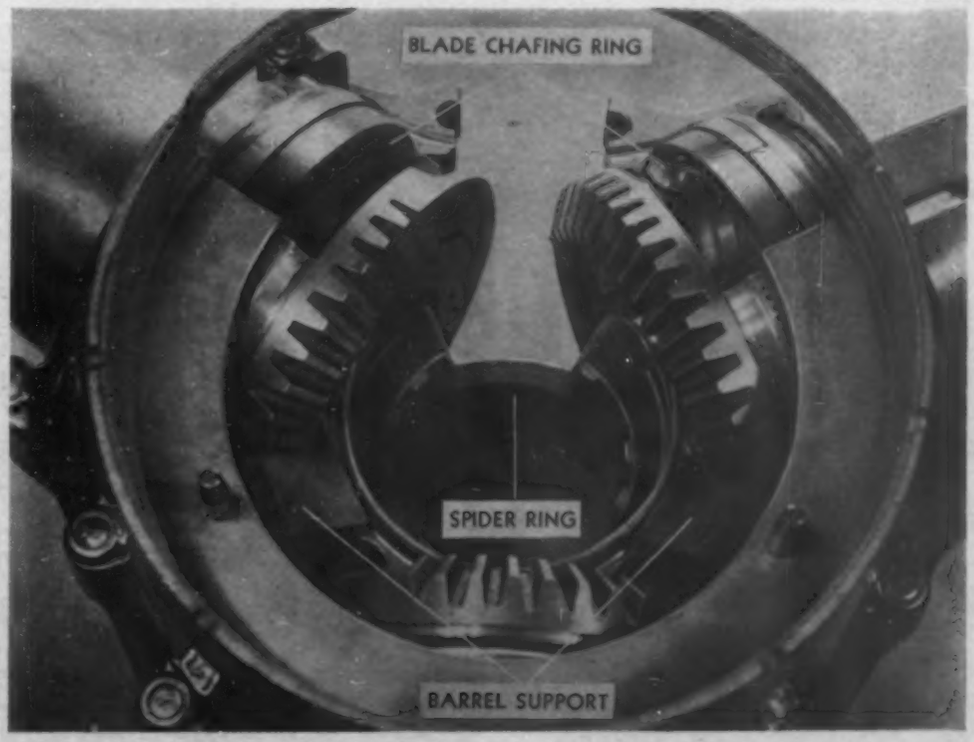
Molded-laminated phenolic propeller parts for aircraft

WHETHER engaged in low altitude strafing or assigned to a bombing mission flying at high altitudes, our fighter planes and bombers must function with maximum efficiency. Contributing to the excellent propeller performance of many of our war planes is the controllable pitch mechanism. It is this device which regulates the angle at which a propeller blade is set in relation to the body of the plane and, therefore, the amount of air scooped up by the blade during each revolution. This action, in turn, affects the speed of the ship. When a plane takes off, the blades are almost at right angles to the direction of flight. This angle is shortened as the plane rises, enabling the blade to cut a deeper swath of air and increase the speed of the plane.

In 76.8 percent of all American military aircraft, Hamilton Standard propellers are reported to be regulation equipment. And a preponderance of these planes now are fitted with Hydromatics, patented propellers whose blade pitch-changing mechanism is operated hydraulically through the use of engine oil whose flow is controlled by a governor. Among the outstanding models that use this type of propeller are the Flying Fortress, Mitchell, Liberator, Havoc, Dauntless and Avenger bombers, and the Corsair, Hellcat, Thunderbolt and Mustang fighting ships.

Flight and fighting conditions impose grueling strains upon all working parts of these military aircraft. Since a high degree of accuracy is demanded of the propeller mechanism which is precision-built to the most exacting tolerances, the assembly must be able to take heavy punishment without deflection. For example, each blade of the propeller on the Consolidated Liberator must withstand a centrifugal load at normal cruising speed equivalent to the weight of a fully loaded Pullman car. While the blades and a great many of the 113 parts that make up this propeller and governer assembly are made from aluminum alloy, there are 5 highly important items which are molded of laminated phenolic material. This plastic not only offers the advantages of economy and lightness, but it has been found to possess dimensional stability approaching that of metal. In a precision-built

PHOTO, COURTESY FORMICA INSULATION CO.



Three laminated phenolic propeller parts are shown in this view of the propeller hub. For photographic purposes the dome-shaped unit which houses the piston and cams that operate the blade pitch mechanism and projects forward from the hub, has been removed

ALL PHOTOS, COURTESY FORMICA INSULATION CO. 2

3

4

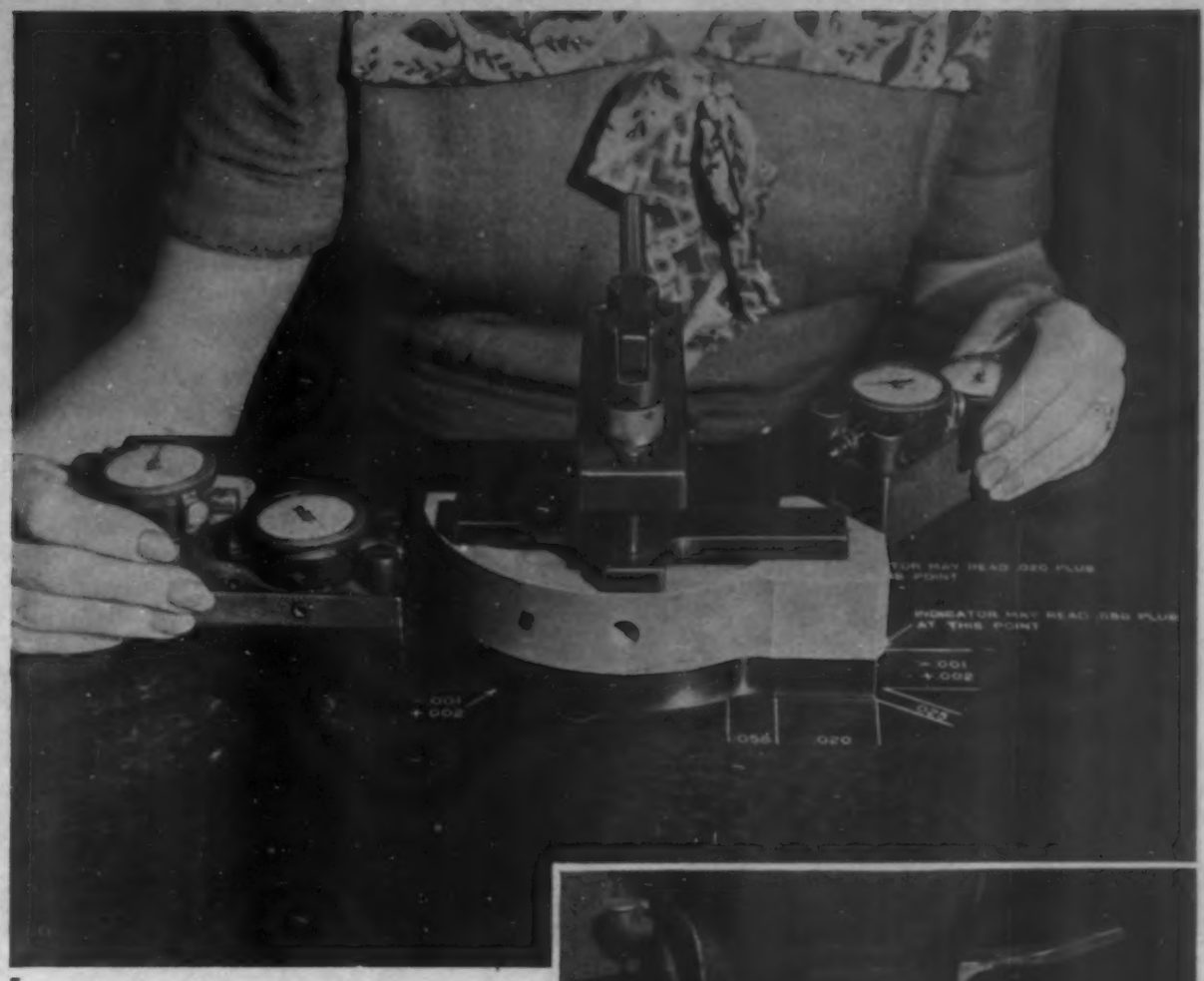
2—Various stages in the manufacture of propeller barrel support blocks. At the top is a molded-laminated slab upon which has been scribed the contours of six blocks. Parts 1 to 11 show the stages in the machining of the supports. 3—Two views of the barrel support blocks. The accuracy of diameter and location of the three holes is maintained by use of a drill jig and carefully ground drills. 4—The jig provides for drilling of three different size holes from three directions

unit which must withstand severe stress and strain, this last characteristic is of extreme importance.

Three of these plastic parts—the barrel support block, the spider phenolic ring and the blade chafing ring—are used in all Hamilton standard controllable or constant-speed propellers, and in the Hydromatics (Fig. 1). A blade butt spacer, a fourth plastic piece, is employed in certain types of 4-bladed Hydromatic models. The laminated phenolic front mounting spacer is used in the spinner of the North American Mustang or P-51.

Barrel support blocks

Three barrel support blocks are needed in the assembly of controllable pitch and Hydromatic propellers. Details of the top and side of this part can be seen in Fig. 3. The blocks are used for alignment and support of the barrel (Fig. 1) which acts as the housing of the spider hub, the central unit of the propeller. The spider which is the central member of the hub, has two, three or more arms according to the number of blades on the propeller, and it is



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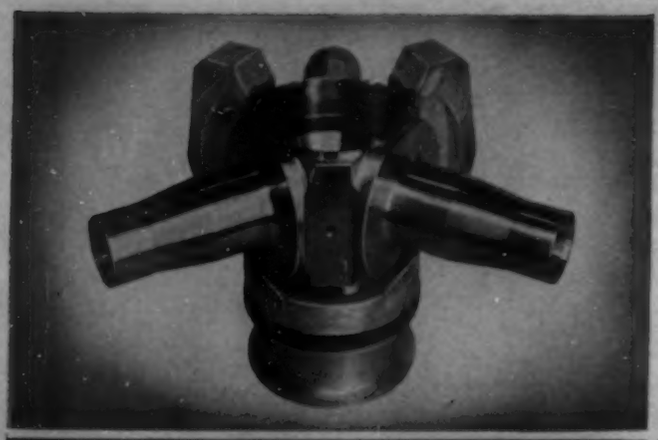
***5**—The completed gage setup for the barrel support blocks. Four micrometer indicators are used to compare the completed block to the master metal template upon which the block under test is mounted. **6**—This vertical milling machine cuts the 3-in. radius on the barrel support block which is milled to a tolerance of ±.001 inch. **7**—After two barrel support blocks have been set up in this jig, a horizontal milling machine mills three angles and then remills one end of each of the parts*

upon these arms that the blades are mounted. A dome-shaped unit which has been removed in Fig. 1 for photographic purposes, projects forward from this hub and houses the piston and cams that operate the blade pitch mechanism. Loads imposed upon the barrel by this dome assembly are transmitted through the laminated barrel support blocks to the spider. Since alignment of the barrel and the two mating parts which are shown assembled in Fig. 1 is achieved by means of shims placed between the barrel supports and the spider, any deformation of the plastic under load or as a result of its inability to withstand the effects of warm engine oil, would be undesirable. Such a change in the plastic support would tend to unbalance the delicately adjusted working parts of the propeller and controllable pitch mechanism, and result in inefficient or faulty performance. The propeller firm found that molded laminated phenolic material met this requirement for dimensional stability. In addition, manufacturing tolerances on such critical dimensions as the length of the support seat which is the cut-out section in the support block (Fig. 3) and



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the outside radius which mates with the barrel, must be held to a total variation of .003 in., +.001 and −.002 inch. On less important dimensions a tolerance of ±.010 in. is permitted.

In the production of these blocks, the first step is the careful manufacture of the blocks of laminated phenolic material from which the parts are formed. After the muslin is coated and impregnated with phenolic resins, the resins are advanced to a certain definite state. This is accomplished by passing the impregnated material through ovens which are maintained at elevated temperatures. The timing of this heat treatment is very exact. During this coating and drying operation sample swatches are cut from the roll at predetermined stages of the operation and carefully checked in the control laboratory to determine the weight of resin picked up. This checking, coupled with close attention to the oven temperature, insures a uniform material. A predetermined number of sheets measuring 36 × 42 in. are stacked to achieve a thickness of $1^1/_4$ inches. They then are molded in the usual hot press manner. To insure against warping or deformation after machining, these molded laminated slabs are immersed into a hot oil bath. This heat treatment relieves any strains which may have been set up during the molding. After cleaning in a carbon tetrachloride bath, the sheets are ready for machining.

After the sheets are cut into blocks measuring $6^3/_4 \times 36$ in., the outside contours of the barrel supports are marked on the surface. At the top of Fig. 2 one of these slabs is shown with the contours of 6 blocks scribed on its face. Parts 1 to 11 in this illustration depict the various stages in the machining of the support. Block No. 1 has been band-sawed from the main slab and ground parallel on its two faces. The next block, No. 2, has been squared on one edge on a horizontal sander. No. 3 shows the block after the seat has been milled, while in No. 4 a $^5/_{32}$-in. radius has been milled on the

8—Spider of a Hydromatic propeller showing two of the barrel support blocks in their correct place. 9—Installation of spider rings on the spider arms of a propeller. 10—A blade chafing ring is inserted between the propeller blade butt and the beveled thrust washer at the assembly of a complete propeller. 11—The butt of a Hydromatic propeller blade showing chafing ring which is severed to allow insertion and adjustment. 12—Seven stages in manufacture of the blade chafing ring

FIGS. 8, 9, 10 AND 11. COURTESY HAMILTON STANDARD PROPELLERS
FIG. 12. COURTESY FORMICA INSULATION CO.

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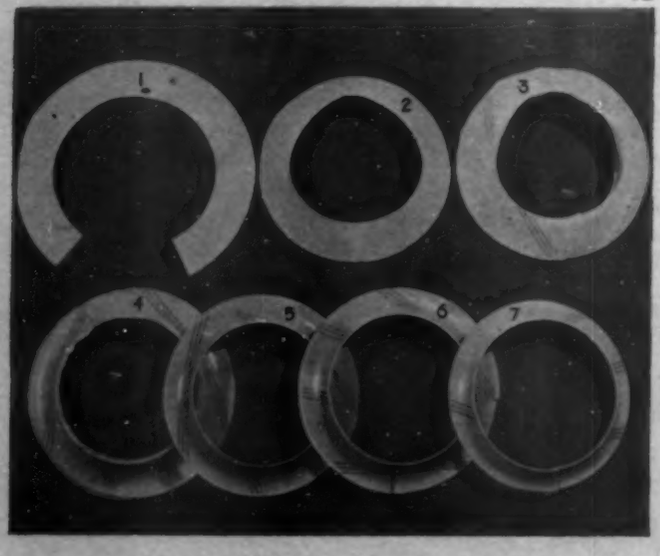

long edges of the seat. The results of the next operation, the milling of the same $^{5}/_{32}$-in. radius on the ends of the seat, can be seen in block No. 5. No. 6 support block has had an oil groove machined on the seat through the use of a straddle mill. The next step is the drilling of 3 holes in the blocks. The accuracy of diameter and location of these bores is maintained by the use of a drill jig and carefully ground drills. The setup for this operation is shown in Fig. 4 where the operator is about to begin the drilling of a long hole which will extend completely through the width of the block. The result of two concave milling operations applied to the faces of the block is illustrated by part No. 8, Fig. 2. No. 9 shows the barrel support after a counterboring operation has been performed on the large hole previously drilled. A vertical milling machine next is employed to cut the highly important 3-in. and $^{3}/_{4}$-in. radii which are milled to a tolerance of ±.001 inch. It is essential that these curved surfaces make a perfect fit with the inside contour of the barrel. A close-up of this milling operation is shown in Fig. 6. The final operation that is performed on these molded-laminated blocks is done in a horizontal mill. Figure 7 shows an operator setting up two blocks in a jig, preparatory to machining 3 angles and remilling one end of the part.

In all machine parts whether metal or plastic, there are certain dimensions which are not as important as others. Accurate knowledge on the part of the designer, of the function of each section of the machine permits him to indicate when this wider latitude in tolerance is permissible. This variation in tolerance requirements is illustrated by Fig. 5 which shows the completed gage setup for the barrel support blocks. Four micrometer indicators are used to compare the completed block to the master metal template upon which the block under test is mounted. A few of the tolerances are indicated on the flat table plate upon which the operator moves her indicators. (*Please turn to page 170*)

16

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14

13—The fabric laminations of the blade chafing ring are sealed into a truncated cone by bringing the ends of the segment together under pressure while they are subjected to slight heat. 14—A complete line of presses used for the molding of the rings. After a ring is removed from the press, it is placed in a cooling form (S) to control its shape. 15—The ring is trimmed on its top face by the use of a circular saw and a jig. 16—A group of inspectors check each of these rings

13

FIGS. 13, 14, 15 AND 16, COURTESY FORMICA INSULATION CO.

Plaskon Helps Pioneer the First Plastic Lithographic Printing Plates!

Another achievement in the growing list of Plaskon Resin applications!

This time it's a commercially proven plastic photolithographic printing plate, developed and patented by the Plastolith Company, Boston, Mass. The base of this new-type plate is made by laminating and coating sheets of paper with Plaskon urea-formaldehyde resin.

The base becomes absolutely waterproof . . . will not shrink or stretch when wet . . . and assures a tough, resilient plate that handles much more easily than other plates. The finished plate restores the old advantages of stone lithography; and new, hitherto undreamed-of printing advantages have been attained. Lightness, permanence, labor- and space-saving . . . plus fine printing qualities . . . are features of these Plaskon-bonded plates. Right now, the entire production is going to Government agencies.

After the war, a wide range of new and improved products made with versatile Plaskon Resins will be available to industry and the individual. At present, our ability to supply Plaskon Resins depends directly upon W. P. B. Allocation Order M-331.

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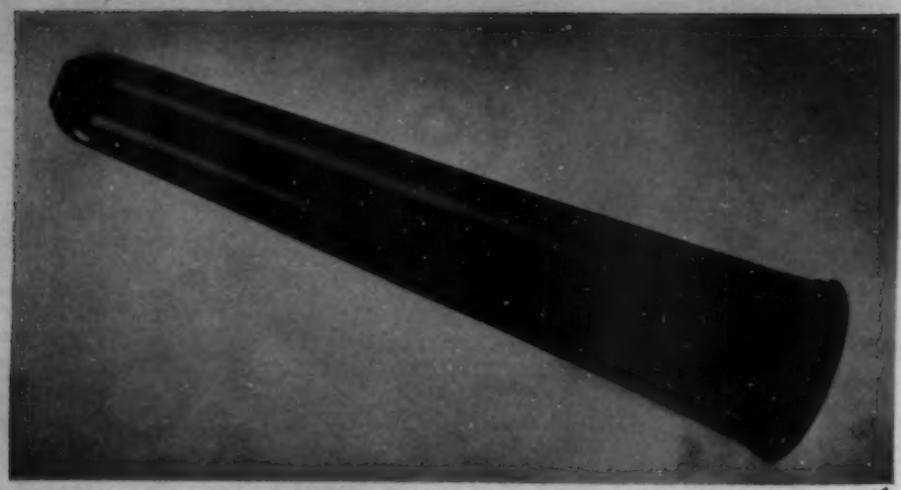
★ RESINS ★

1. The first step in printing from plastic plates is application of a coating of developing ink after exposure under a carbon ray lamp has transferred the desired image to the plate surface.

2. Developing ink clings to the lines of the image; excess ink covering the unmarked surface is washed off.

3. Prior to being put on the press, the plate is carefully checked.

4. Here the plastic plate is being clamped on the offset printing press.



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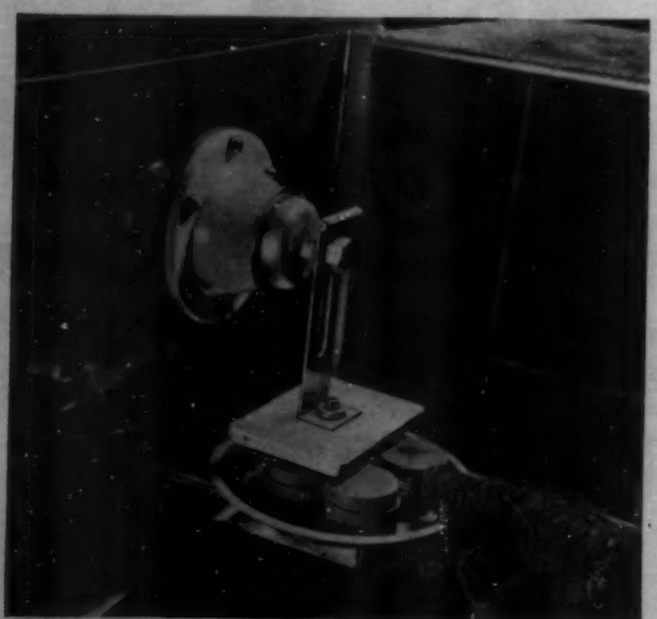
A fire-fighting horn



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THE engineering pages of MODERN PLASTICS have been following new installations of high-frequency oscillators and printing case histories of parts molded through the use of this form of heat.[1] In the latest application to be checked, an RCA oscillator has solved the many problems that developed in the molding of a $10^{3}/_{4}$-in. long horn of medium-impact phenolic material.

This horn (Fig. 1) is a very necessary part of a 4-lb. CO_2 fire extinguisher which has become an important adjunct to many divisions of our Armed Services. When the CO_2 that is carried in the steel extinguisher bottle under a pressure of 850 p.s.i., is permitted to escape from the container, it expands many thousands of times and drops in temperature to approximately −110° F. The resultant white, soupy fog serves to smother the fire by cutting off all air from the burning object. If it were not for the horn, air would mix with the CO_2 as it comes from the minute valve orifice in the extinguisher bottle, dissipating the gas and making it less effective. In addition, the phenolic horn which is connected to the gas bottles with a swivel joint, enables the fireman to direct the stream of fog at the base of the fire. This small extinguisher has an effective range of 8 ft. when used out of doors and a much greater range when employed within the confines of a building.

The fire-fighting horn is designed with an average wall section of $^{3}/_{32}$ in. and, as can be seen in Fig. 1, it has a long tapering shape with a diameter of $2^{1}/_{2}$ in. at the large end. With this shape and wall section, the force plug cannot vary from the true center. The minute the plug goes off center it "molds through" on one side of the horn and leaves a heavy

[1] "Molding with radio frequency," MODERN PLASTICS *20*, 83–85, 132, 133 (May 1943).
"New application of heatronic molding," MODERN PLASTICS *21*, 103–104 (Nov. 1943).

1—This $10^{3}/_{4}$-in. horn, which is molded of medium-impact phenolic material, is used on a CO_2 fire extinguisher. 2—After the safety cage of the RCA oscillator is opened, the hot preforms which are held in a pie tin are removed from beneath the adjustable electrodes. 3—The knurled brass inserts are screwed to threaded pins. The high-frequency oscillator can be seen in the background with the safety cage in a closed position

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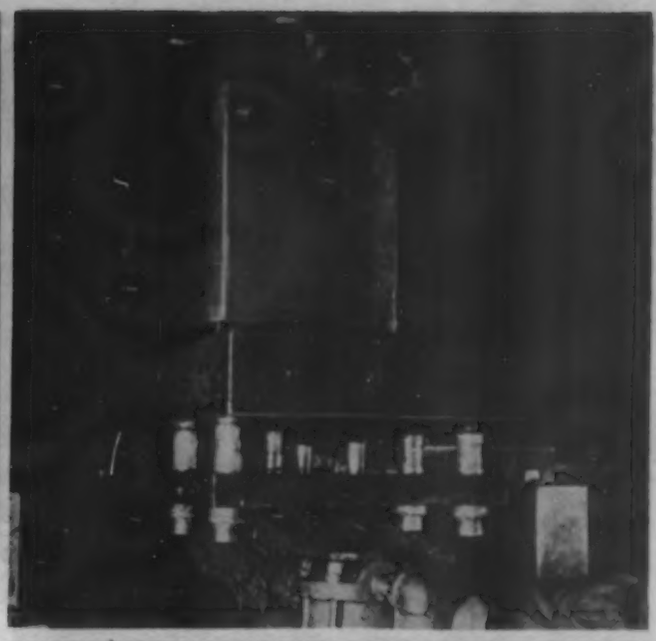

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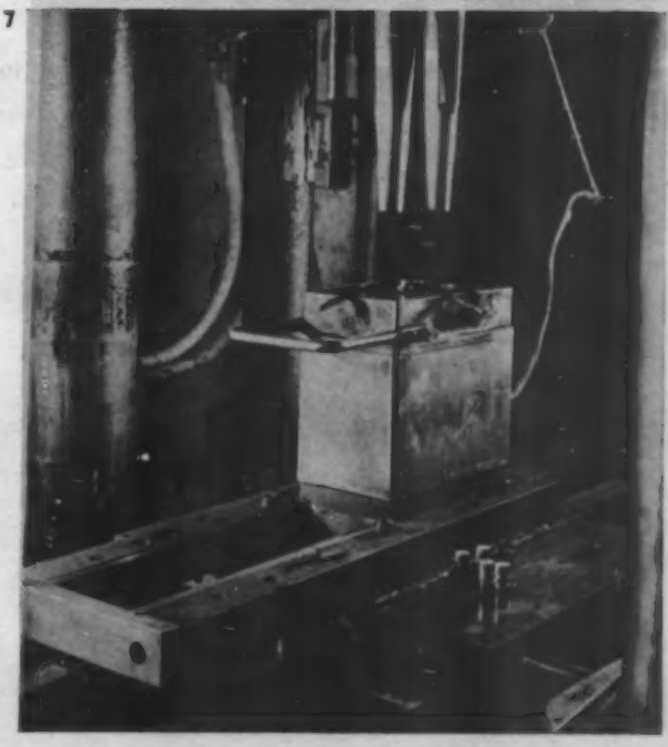

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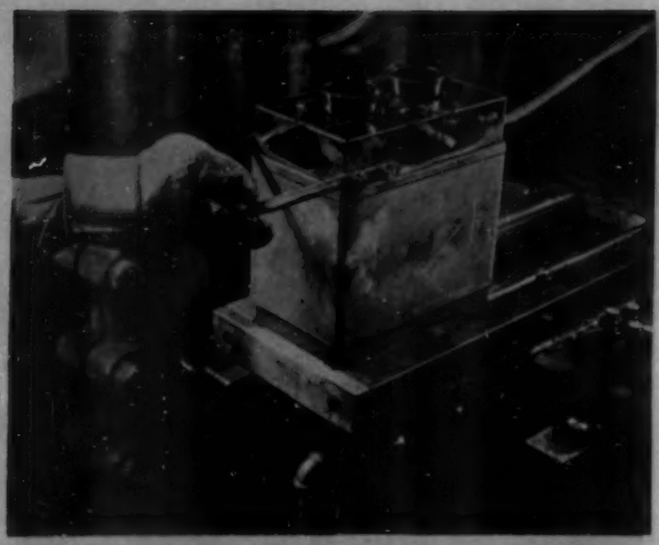
wall on the other. In addition, in "molding through" the force plug scores the cavity. It was for these reasons that this particular job became known as a "headache." Not only did a high percentage of rejects and a large number of down-time hours eat up the small profit but they put the job completely in the red.

When the molder decided to use a high-frequency oscillator for the molding of this horn he was motivated by a desire to overcome the difficulties encountered in keeping the force plugs lined up. He did not anticipate an appreciable reduction in the curing time since only a 2-min. cure was necessary before high-frequency preheating was adopted. However, use of an oscillator has cut the cure to 1 minute and 20 seconds with the same acetone extractables.

This job is being molded in a 2-cavity die set up in a press with a 21 in. diameter overhead ram, with a line pressure of only 250 pounds per square inch. However, even with this low line pressure, a total pressure of approximately 40 tons is exerted on the small ends of the two force plugs. This represents a pressure of about 20 tons per plug. Before the high-frequency oscillator was installed for preheating, the material in the molds did not flow at once. Therefore this entire pressure was brought to bear. After a short time under pressure the material would soften and flow—but not in a uniform manner. As can be seen, a terrific strain was placed upon the force plugs in the interval between the time the pressure was brought to bear upon the material and the time it started to flow. The strain became even greater the moment the force plugs were bent. In fact, as soon as one or the other of the plugs was bent it would go completely out of line in the next shot. The molds then had to be dismantled, the force plugs straightened and the cavities polished if the plug happened to hit the side wall after it bent.

A knurled brass insert with an internal pipe thread is molded in the small end of each piece so that the horn can be screwed to the swivel arm of the CO_2 bottle. The method of loading this insert into the mold is shown in Fig. 5. After

4—Upon removal from the oscillator, six preforms are dropped into each mold cavity. 5—In order to load the inserts into the molds, the chase is pulled out of the press on a set of slides. This movement exposes openings in the bottom of each cavity. The knock-out set-up can be seen in the foreground. 6—The mold in a closed position. 7—The molding cycle completed, the force plugs are raised and the chase pulled forward



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the insert is screwed to a threaded pin (Fig. 3), the chase is pulled out of the press on a set of slides. This movement exposes an opening in the bottom of each cavity. After the operator has slipped a brass insert into the bottom of the far cavity, he slides the chase part way back onto the base plate thereby covering the hole in this cavity and keeping the insert in place. The insert for the second cavity is assembled in the same manner, and the chase pushed back into molding position.

This fire-fighting horn uses a total of 132 grams of phenolic material—6 preforms, each weighing 22 grams. As shown in Fig. 2, 12 preforms, or enough to load two cavities, are placed in a metal tin and centered under the adjustable electrodes of the high-frequency oscillator. With the preforms in position the safety cage is closed, and the material is allowed to preheat for a period of 35 seconds. The equipment is designed so that the power cannot be turned on until the safety cage of the oscillator is in a closed position (Fig. 3). After this heating period the preforms are removed from the oscillator and 6 preforms are dropped into each mold cavity (Fig. 4). Then the mold is closed. It is at this point that the major advantages to be derived from the use of a high-frequency oscillator come to light.

As stated above, when high frequency was not used the force plugs came down against the material and the entire pressure of about 40 tons was exerted for an appreciable length of time before the material started to flow. With high frequency heating, however, there is no appreciable slackening in the speed of the mold closing, so at no time is anywhere near a pressure of 40 tons exerted on the plugs. The continuous closing action of the press ceases only when the mold is completely closed. This means, therefore, that the medium impact material is in such a soft and partially plasticized state when it comes from the oscillator that it flows almost like water around each plug until it completely fills out the molds.

Instead of the usual high-pressure steam, this company uses a high-pressure water system (*Please turn to page 170*)

8—A foot lever actuates the knockout mechanism, a portion of which is visible in the lower foreground, and raises the 2 fire-fighting horns about an inch. 9—The phenolic horns are removed from the molds by hand. 10—The threaded pins are inserted in a vise where they are unscrewed from the molded-in inserts. 11—The high-frequency oscillator was used for the experimental molding of this paper sundae dish holder

11

G.I. MUSIC-MAKER

OCARINAS AND TONETTES made of Tenite furnish the jive for many a jam session held in foxholes, canteens behind the lines, and on troop convoys. These easy-to-play, pocket-size instruments are issued by the Army to troops now serving overseas.

An extremely tough plastic, Tenite withstands the banging around and rough-housing to which these musical instruments are subjected. Tenite is shatterproof and dirt-resistant. It is injection-molded at the fastest speeds attained with plastics to produce tonettes, ocarinas, bugles, whistles, and other products for the U. S. Army.

Information on Tenite and its adaptability to your product will be supplied upon request. TENNESSEE EASTMAN CORPORATION (Subsidiary of Eastman Kodak Company), KINGSPORT, TENNESSEE.

• • •

TENITE REPRESENTATIVES . . . *New York*, 10 East 40th Street. *Buffalo*, 1508 Rand Building. *Chicago*, 1564 Builders' Building. *Dayton, Ohio*, 305 Third National Building. *Detroit*, 904-5 Stephenson Building. *Leominster, Massachusetts*, 39 Main Street. *Washington, D. C.*, 1125 Earle Building . . . *Pacific Coast:* Wilson & Geo. Meyer & Company—*San Francisco*, 15th Floor, 333 Montgomery Street, *Los Angeles*, 2461 Hunter St., *Seattle*, 1020 4th Avenue, South.

Tonettes molded by Elmer E. Mills Corp. for Chicago Musical Instrument Company

Ocarinas molded by Plastics, Inc., for Fred Gretsch Manufacturing Company

TENITE *an Eastman Plastic*

Life On The

(*Above*) **PERFECT MATCHES** are these BEETLE* buttons because BEETLE molding compounds assure uniform strength, unvarying color, and resistance to dry-cleaning and laundering.

REVISED ALLOCATIONS of plastics materials make BEETLE available for a larger supply of closures for civilian use. Keep in touch with your molder on changes that may occur on the availability of material for molded plastic needs.

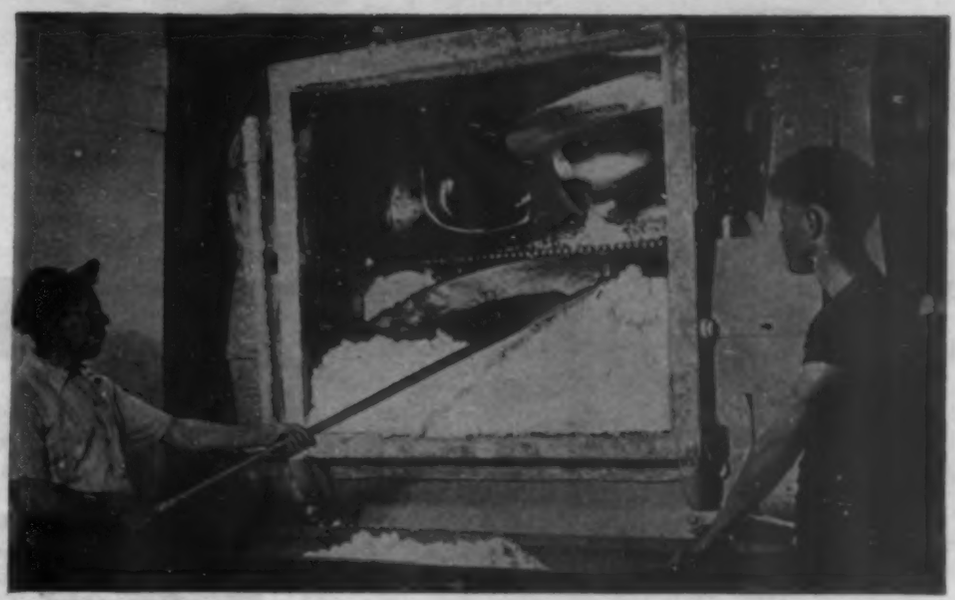
(*Below*) **URAC* WEATHERPROOFED** paperboard containers carry merchandise to all parts of the world because of the qualities of water-resistance and strength imparted by Cyanamid's URAC resin adhesives to solid fiber and corrugated paperboard.

PHOTO COURTESY UNITED AIR LINES

Plastics Newsfront

FROM MIXING MILLS like the one at right at the plant of the American Cyanamid Company in Bound Brook, New Jersey, come BEETLE molding materials to be transformed into plastic parts for ships, planes, and other equipment for our armed forces as well as many civilian applications. Its use for the production of civilian products such as radio cabinets, clock cases and some other peacetime products is now being considered and material allowed.

BEETLE molding compounds, in both powder and granular form, are supplied in many plasticities designed to meet job specifications and molding conditions. BEETLE—the plastic that is all color—in all colors—combines brilliance with permanence in a wide selection of different colors, either translucent or opaque. Complete information on the best current molding practice, properties of finished parts and pertinent facts regarding piece design and application of BEETLE and other Cyanamid plastics are available upon request.



(*Above*) **AMERICAN INGENUITY** has put into full swing the production of amphibious transport gliders, one of the newest of our aircraft developments. Designed and built according to Army-Navy specifications, molded plywood bonded with synthetic resin adhesives are used to combine lightness, strength and rigidity in construction. Several Cyanamid resins for use as both hot and cold set adhesives are available to meet various fabrication conditions. Further information will be supplied on request.

(*Above*) **CYANAMID CHEMISTS** are working with the most modern equipment to create new uses for plastics. Shown here is a photo taken at the Cyanamid Research Laboratories from the sound and color film, 'This Plastic Age, produced by Modern Plastics magazine. It covers the activities of the entire plastics field and is for showing to manufacturers and molders, war plants, technical and educational groups, museums of art and science in the United States, Canada, Spain and China.

* Reg. U. S. Pat. Off

AMERICAN CYANAMID COMPANY

PLASTICS DIVISION

30 ROCKEFELLER PLAZA, NEW YORK 20, N. Y.

CYANAMID PLASTICS · Beetle · Melmac · Urac · Melurac · Laminac

More than 30,000,000 pounds sold to the plastics industry . More than 30,000,000 pounds sold to the plastics industry . More than 30,000,000 pounds sold to the plastics industry .

Advances in plastics during 1943*

by G. M. KLINE

THE chronology of plastics progress during 1943 is wholly associated with the demands of total war. Plastics have assumed jobs in this national emergency which stand in amazing contrast to their former peacetime roles. The versatility and potentialities of these synthetic materials have become even more evident in these wartime applications. The new materials and techniques which have been developed to meet the exigencies of the hour are far-reaching in their possibilities for influencing postwar use of plastics.

Materials

The safeguards of censorship have prevented extensive descriptions of many of the wartime arrivals in the materials field. Because these pioneering efforts constitute an interesting and significant phase of development during this period of vigorous plastics activity, a brief survey of some of these newcomers is presented.

Synthetic replacements for natural mica—one of the most critical war materials because it is a vital component of radio and electrical apparatus— are being developed by several companies. One of these has produced a series of commercial products called Polectron.[1] Polectron is said to have an unusual combination of low dielectric loss, high temperature stability and superior water resistance, although the mechanical strength of the resin as now made is still relatively poor. Immediate uses for the material, such as dielectric sheets in condensers, do not call for a high degree of mechanical strength.

An inorganic mineral element, silicon, has been combined with organic radicals composed of carbon and hydrogen to produce a new group of plastics called Silicones.[2] Silicones are said to be resistant to temperatures as high as 500° F. which suggests their suitability for use in electrical insulation where such conditions may be encountered.

Another new material, as yet a little-known name on the plastics roster, is Penacolite. This is said to be a phenolic-type thermosetting resin which cures rapidly at temperatures from 60 to 150° F. under nearly neutral conditions. This type of resin may eliminate many of the difficulties in assembly gluing of wood or plastic-plywood parts for use continuously exposed to the weather.

Polystyrene has fulfilled many difficult assignments in wartime electronic and aircraft equipment.[3] Styraloy,[4] a recently developed elastomeric styrene derivative, is reported to have properties which make it eminently suitable for electrical applications at both high and low temperatures.

A long-awaited entry in the plastics field is an adhesive which will permit the bonding together of metal, wood, plastics, ceramics, fibers and rubber in any desired combination. A possible solution to this problem has been found in Cycleweld and Reanite cements, thermosetting plastics which are applied to the surfaces of the units to be bonded and then cured under heat and pressure. This process[5] is said to form structures which are stronger, lighter and cheaper than those joined by conventional methods.

PHOTO, COURTESY CHRYSLER CORP.

Cycleweld cement, a thermosetting plastic which permanently bonds together metal, wood, plastics, ceramics and rubber in desired combinations, produces structures that are strong, light and inexpensive. Here applied to skin and edge with a stripping gun, it replaces riveting in the assembly of a plane's metal wing flap

Reinforced plastics which permit large-volume production of low-cost, lightweight, high-strength structures offer many advantages beyond the replacement of critical aluminum and magnesium. Several new resins[6,7] which will form satisfactory bonds at low or contact pressures and thus eliminate the need for costly dies have been created, and special papers, cotton[8] and rayon fabrics, and glass fiber cloths[9] have been developed as reinforcing materials. These low-pressure laminated plastics attract interest because they make possible the fabrication of huge structures heretofore considered impractical and even impossible for plastics.

Resin-impregnated wood has become an important factor in maintaining an adequate supply of propellers for our expanding Air Forces. A plant with facilities for producing 50 times the volume of Pregwood available prior to the war

* Presented before the Rubber and Plastics Group of the American Society of Mechanical Engineers, New York, N. Y., Dec. 2, 1943.

PHOTO, COURTESY VIRGINIA-LINDSLEY CORP.

Use of low pressures and reduced temperatures now makes possible the economical molding of large laminated structures of complex shape in small quantities. The inexpensive molds are of wood, cement or plaster of Paris; air, water or steam pressure is applied by the rubber bag method. The piece in this mold is over 12 ft. long

is now in operation. The resin-impregnated and compressed maple boards are bonded by means of electrostatic high-frequency heating of thermosetting phenolic glues into blocks from which the propeller is carved. Other applications of this wood-plastic material include electrical insulation, bearing plates, skis and ventilating fans.[10–14]

A new rubber-like product, Paracon, made by the condensation of dibasic acids with glycols or by the condensation of hydroxy acids was announced.[15] The elongation at break of these polyesters is said to average 400 percent with an average tensile strength of about 1700 pounds per square inch. Important progress was also made in the production and application of polyethylene and its derivatives, but publications on this subject were limited to the patent literature.[16,17]

Significant reports were published concerning materials which are relatively new to the industry and which have been allocated almost completely to war uses. These pertained to the processing and properties of nylon,[18–20] vinylidene chloride,[21–23] and vinyl chloride-acetate plastics.[24–27] The development of an improved heat-resistant methacrylate molding compound was announced.[28] A low-density cellophane product which has some unusual properties and applications was described.[29] Other noteworthy papers dealt with phenolic pulp preforms,[30] plastics from redwoods,[31,32] soybean-modified phenolic molding compounds[33] and starch plastics.[34]

Molding and fabricating

There have been a number of notable advances in molding and fabricating techniques during 1943. These have served greatly to extend the horizons of the plastics industry. Low-pressure laminating, post-forming of laminates and heatronic molding have passed rapidly through their experimental stages to become new and vital tools in the production of plastic parts for our armed forces.

After several years of intensive research it now is possible to mold laminated structures at low pressures and at reduced temperatures with a consequent reduction in molding costs. The new technique also removes the size limitations which presses and steel molds had placed upon molded plastics applications, and makes possible the economical production of small numbers of parts, the former insurmountable obstacle to many potential users of plastics. The molds for low-pressure molding can be fashioned from wood, cement, plaster of Paris or cast metal. A rubber bag inserted in the cavity or a rubber blanket laid over the mold and clamped tightly at the edges provides the means for applying uniform pressure to the closed dies by means of air, water or steam. The low-pressure laminates compare favorably mechanically with high-pressure laminates and possess the additional advantage of permitting the formation of complex shapes without rupture of the fibrous reinforcing materials.[35,36]

Post-forming of thermosetting materials had its origin in the aircraft industry. Many intricate machines have been devised to make metal sheets take the complex shapes required by that industry. With this background of experience in handling sheet metals, it is not surprising that this same industry was the first successfully to apply sheet-forming methods to plastic laminates to produce a wide variety of parts used on aircraft. Again, the important factors in its present and future uses are the ability to produce a few parts with neglible mold costs, the low pressures involved which make unnecessary costly investments in presses and auxiliary equipment, and the simplicity of the operation which is not dependent upon the use of skilled labor. The process consists essentially of subjecting the material to a temperature at which it becomes thermoplastic and quickly forming it over molds made of wood or other suitable materials.[37–39] The surprising feature is, of course, the residual thermoplasticity retained by these thermosetting laminates which by definition were "infusible."

The principle of radio frequency heating has been applied to the heat sealing of packaging materials coated with thermoplastic films. Power is applied at the meeting point of two revolving electrodes and the material, which passes between them, is fused together much as two pieces of cloth are stitched in a sewing machine

Electrostatic high-frequency heating was first applied in the plastics field to the curing of resins used in the bonding of plywood and the manufacture of high-density resin-impregnated wood.[40] During 1943 this electronic method of heating was adapted to the molding of thermosetting materials. Called "heatronic molding," the process as applied to compression molding consists in heating the powdered or preformed material to molding temperature in the electrostatic field outside of the molding press, followed by a quick transfer to the mold and rapid closing of the press to obtain flow prior to hardening.[41–44] The advantages of heatronic molding are ready molding of impact grades of materials, shorter cycles, lower pressures, less abrasion of the molds, less pin-breakage and displacement of inserts, and adaptability to molding of thick cross sections.

Other developments and improvements in molding processes and fabrication techniques were described in the literature during the course of the year. Transfer molding[45, 46] and mold design[47] were reviewed and a comprehensive survey of molding tolerances[48, 49] was made. Recommendations were published concerning good practices in the machining of laminates.[50, 51] Another application of electronics to plastics problems was achieved in the sealing of packages made up of thermoplastic film by passing the lapped material through a high-frequency electrostatic field.[52]

Applications

A recounting of new uses of plastics during 1943 is necessarily another chapter in the story of meeting war matériel needs with these synthetic products. Plastics are used by our armed forces in every sphere of the war. It is noteworthy, however, that there were nearly twice as many reports published on aircraft applications of plastics as on all other war uses. This evidence of interest and activity in plastics on the part of the high-priority aircraft industry augurs well for a continuing and expanding market for these materials in that field. This contact has been a fortunate one for the plastics industry in that it has led to the development of methods for utilizing plastics for the manufacture of relatively small numbers of parts of moderately large size as compared with prewar emphasis on mass production of small shapes. It also has brought a demand for engineering data pertaining to the properties of these materials in order to use them most effectively in structural and semi-structural parts. The accumulation of this technical data during the war period will pave the way for broader industrial postwar applications of plastics.

Several reviews concerning the utilization of plastics for aircraft purposes were published.[53–58] Other reports described specific applications, such as propellers,[59] windshields,[60–63] ammunition boxes,[64] gun turrets,[65] engine parts,[66–68] antenna masts,[69] jettison tanks,[70] barrage balloon valves,[71] speed indicators,[72] bomb racks[73] and miscellaneous fittings—fairings, doors, and wing and tail parts.[74, 75] Plastics were used in drop-hammer and hydraulic press punches for forming metal sheets into aircraft components.[76–78]

A commendable job has been done by the National Aircraft Standards Committee in the standardization of plastic tubing and tube fittings for use on aircraft.[79] This reduction in the number of sizes and shapes of parts makes the use of plastics feasible and economical and simplifies inventory and servicing problems. A comprehensive survey of the activities of various technical committees with respect to research, specifications, standardization and publications was issued, following a meeting held in Washington to coordinate such

PHOTO, COURTESY RCA VICTOR DIV., RADIO CORP. OF AMERICA

Radio frequency heating, as applied to the molding of thermosetting materials, consists in preheating the powdered or preformed material in the electrostatic field before transferring it to the mold. Here the operator places the preform between two electrodes (in safety cage) connected to the generator at the left. In a few seconds it will have reached a high degree of plasticity and be placed in the compression press at the right

work, particularly as it applies to the aircraft field.[80]

Many developments in the use of resin-bonded plywood for aircraft construction were reported during the year. This triple alliance of the aircraft, plastics and wood industries has resulted in the transformation of an old material into a versatile product adaptable to the methods and needs of modern industry. Further progress in improving the properties of plywood and extending its markets is to be expected from the current activity in the synthesis of new resins which will produce satisfactory bonds at very low pressures and room temperature under practically neutral conditions.

The construction of airplanes from plywood was discussed in several papers published during 1943.[81–87] Special problems involved in molding monocoque structures from sandwich materials comprising high-strength facing sheets bonded to low-density cores were reviewed.[87–88] The use of resin-bonded plywood for seaplane floats,[89] refrigerator cars[90] and tubular antenna masts[91] was reported.

Advances in synthetic resin glues[92–95] and in bonding and forming techniques[96–98] were described. Problems involved in formulating and evaluating finishes for plywood were analyzed.[99] The behavior of plywood under various stress conditions[100, 101] and in delamination tests[102] was reported.

A variety of items developed or made during 1943 from plastics for the armed forces were described.[103–106] Special articles considered in detail such applications as fuzes,[107]

PHOTO, COURTESY DOUGLAS AIRCRAFT CO., INC.

In order to standardize plastic tubing and tube fittings for use on aircraft, a test program was devised. Tests of threaded fittings proved that the threads, being in shear, did not strip and were, in fact, stronger than other portions of the body of the fitting itself

bomb recorder frames,[108] gas mask parts,[109] snake bite kits,[110] canteens,[111] helmet liners,[112] insignia,[113, 114] hand grenades,[115] foot tubs,[116] handwheels,[117] training bayonets,[118] "walkie-talkie" microphones,[119] bugles,[120] tank periscopes,[121] ship propeller bearings[122] and binocular carrying cases.[123] Excellent surveys of the large-scale utilization of plastic-coated fabrics for the fabrication of various types of military equipment were published.[124] The use of resinous coatings for protecting steel shell cases against corrosion[125] and for other military requirements were reviewed.[126]

The nonmilitary applications of plastics during 1943 were restricted to essential civilian and industrial requirements. Many of these represented replacements for materials, such as rubber, leather and copper, the supplies of which were even more critical than that of plastics. Polyvinylidene chloride was used as piping,[127–130] screening and moisture-proof packaging material.[22, 23, 131, 132] The vinyl resins were employed extensively as flexible electrical insulation[133] and in soles for shoes.[134] The ion exchange resins were utilized in many industrial processes for purification of water.[135, 136]

Reviews were published discussing the uses of plastics in adhesives,[137, 138] medical supplies,[139] printing plates,[140, 141] synthetic textile fibers,[142] railway equipment[143–145] and building construction.[146, 147] Significant developments in improving the optical properties and extending the optical applications of plastics were described.[148–151] Large tonnages of these synthetic materials were used in protective coatings; advances in this field were discussed in several papers.[152–155]

Properties, testing, specifications

A record number of papers describing the results of experimental work on various properties of plastics were published during 1943. These marked a continuation of efforts to supply the military services with the engineering data required for proper use of plastics in their war applications. Such publications are providing a foundation of technical information upon which the plastics industry can build diverse and substantial markets in new fields after the war.

The American Society of Mechanical Engineers through its Rubber and Plastics Group sponsored many of these technical papers. Reports on investigations of the bearing strength of plastics[156] and their behavior under sustained vibrations[157] were published by the Society. The effects of continuous heat on phenolic materials[158] and various mechanical properties of cellulose acetate[159] were described in other A.S.M.E. papers. Three papers on plastics were presented at the semi-annual meeting in Los Angeles in June; these pertained to thermo-elastic forming of airplane parts,[20] properties of Fiberglas laminates,[160] and a discussion of laminates made by combinations of wood with cloth and paper.[161] The annual meeting of the Society in New York in December was marked by six further contributions to the fund of information on plastics. These reports concerned paper-base laminates,[162] tubings and fittings for aircraft,[163] fatigue behavior of resin-bonded plywood,[164] creep properties of phenolic plastics,[165] printing plates,[166] and application of plastic films and solutions to glass to prevent scattering during air raids.[167]

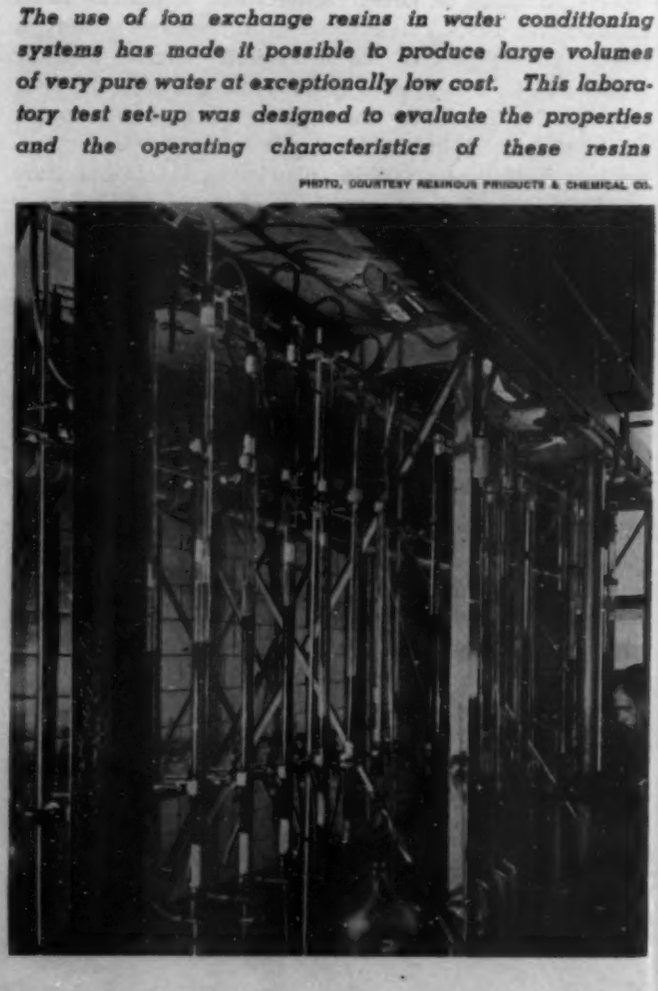
Three outstanding papers on the strength characteristics and testing of plastics were presented at the annual meeting of the American Society for Testing Materials in June. These related to impact testing,[168] flow of plastics under load,[169] and correlation between impact and fatigue tests.[170]

An important symposium on the engineering properties of plastics from the viewpoint of their application to aircraft components was held during February under the sponsorship of the Army-Navy-Civil Technical Subcommittee on Plastics. Three papers giving detailed information regarding the mechanical strength of laminates were presented.[87, 171, 172] Other reports describing experimental work conducted by the Army Air Forces and Naval Air Experimental Center on plastics were published during the year.[173–175]

Several papers described investigations of the physical properties of the increasingly important group of elastic plastics; these were concerned with their fatigue resistance,[176] abrasion resistance,[177] stress-strain characteristics,[178] and low temperature brittleness.[179] (*Please turn to page 178*)

The use of ion exchange resins in water conditioning systems has made it possible to produce large volumes of very pure water at exceptionally low cost. This laboratory test set-up was designed to evaluate the properties and the operating characteristics of these resins

PHOTO, COURTESY RESINOUS PRODUCTS & CHEMICAL CO.



Effects of thermo-elastic forming on properties of thermosetting laminates

by W. I. BEACH*

SUBSEQUENT to the development of the thermo-elastic forming process, there was an urgent need for pertinent factual data concerning the properties of formed laminates. Consequently an extensive testing program was undertaken primarily to keep pace with the growth of forming technique. This program had as its objects, first, the investigation of degree of cure and its primary influence on the formability characteristics, and second, the effect of reshaping flat sheets upon physical properties. The use of formed plastics was contingent upon unknown factors, namely, the extent to which forming reduced strength and performance afterwards under service conditions. Conventional types of plastics, except perhaps the latest high-strength reinforced products, are notably weak in tension, shear, flexure, toughness and stiffness as compared to the aluminum alloys. This weakness has relegated plastics to non-structural and an occasional semi-structural application. Hence, if forming resulted in breaking down the resin structure beyond all practical uses, it would by necessity be curtailed if not abandoned entirely.

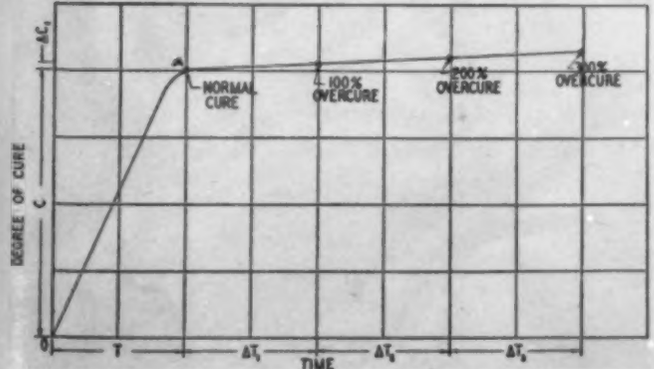
Degree of cure

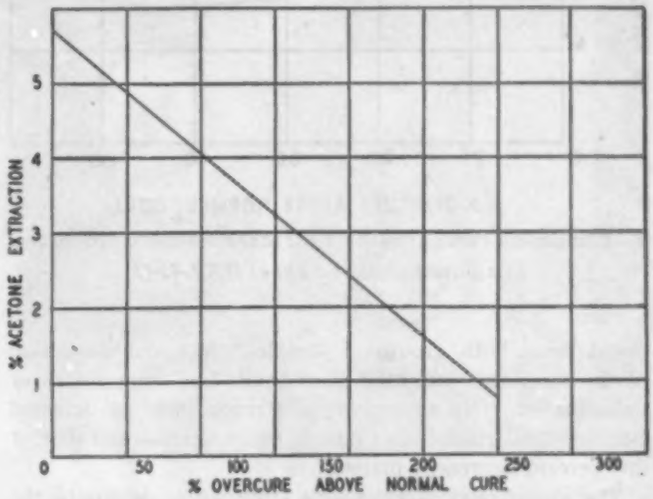
It is difficult to define accurately the factors which constitute a fully cured material. The conventional practice, advocated by the laminating industry, has been to establish the curing cycle by methods akin to trial and error. For instance, it can be proved by cure versus time curves that for all practical purposes the polymerization takes place in a relatively short period of time. In Fig. 1, a representative curve is shown.

It is to be noticed that between points O and A, the slope of the cure curve is the greatest. Beyond A, the slope flattens and becomes almost static. Observing this, then, it is reasonable to designate point A as the normal or full cure of the resin. In order to obtain a cure equal to $C + \Delta C_1$, the press must operate a period equal to $T + \Delta T_1$. Obviously, it is not economical to operate press equipment for an additional period to obtain such a small increase in cure.

* Chief plastics engineer, North American Aviation, Inc.

1—*Degree of cure versus time for laminated phenolic sheet NA2-4141*





2—*Acetone extraction versus overcure for laminated phenolic sheet NA2-4141*

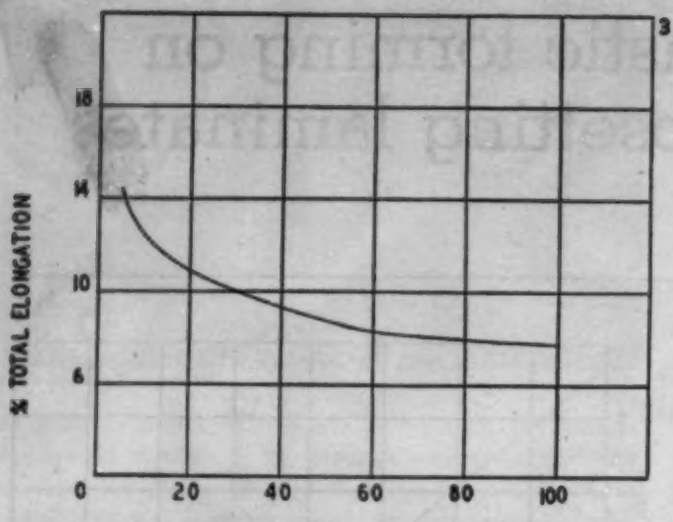
Much confusion and many differences of opinion exist whenever an attempt is made to establish the demarcation between an undercured and fully cured product. The Navy specification prescribes an acetone extraction test. This test, like others, is a means for determining an approved material, but unfortunately an acetone extraction test does not appear to have a particular bearing upon the formability of a thermosetting product or its direct relation to cure. Hence, for illustrative purposes, an arbitrary point represented by A located on Fig. 1 is selected as normal cure.

Effect of cure upon formability

Several different types of materials were furnished for these tests by a number of laminators. One set of samples treated for normal cure and 20, 40, 60, 80 and 100 percent overcure consisted of slightly plasticized phenol-resin, fabric-base laminate. The other set, which consisted of cresylic-resin, fabric-base laminate, was processed to normal cure and 50, 100, 150 and 200 percent overcure. Although these tests at present have not been completed, enough data are available to indicate the trend of the relation between cure and formability.

By acetone extraction determination, it was found that the cresylic samples possessed a 5.70 percent extraction for normal cure and 1.58 percent extraction for 200 percent overcure. A curve of acetone extraction versus degree overcure is seen in Fig. 2.

All specimens were subjected to a 90° right-angle bend over a rod of $^1/_{16}$-in. radius. Since the samples were sheets approximately .062 in. thick, a $^1/_{16}$-in. radius bend was considered a satisfactory test. The same conditions were im-



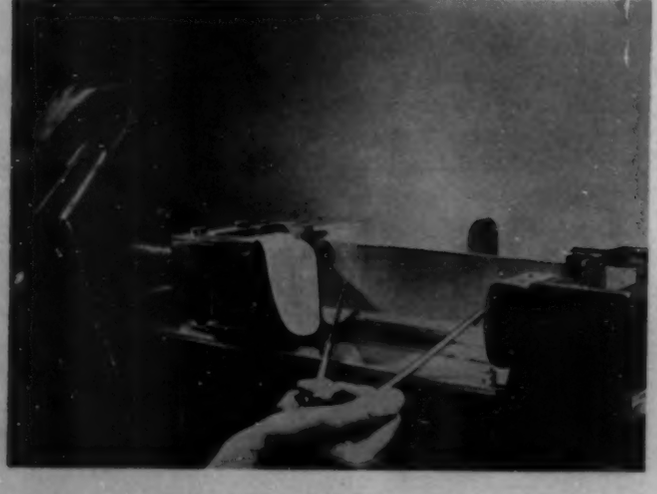
3—Elongation versus overcure for thermo-elastic processed laminated phenolic sheet NA2-4141

posed upon both groups of samples. A visual inspection of the specimens indicated good bends free from cracks or delamination. No appreciable difference could be detected between the formability of normal cured samples and that of 200 percent overcured material.

The phenol-resin samples were stretched to determine the effect of cure upon elongation. Figure 3 shows a curve of percent overcure versus percent elongation. As would be expected when prolonged curing takes place, the material becomes less susceptible to stretching. Preliminary tests conducted upon normal cured specimens have shown that material elongated from 2 percent to approximately 15 percent exhibited a corresponding Poisson's ratio between 0.60 and 0.75. Consequently, it is believed that the resin was sufficiently elastic to permit the longitudinal threads parallel to the direction of the force to move closer together and at the same time straighten out. However, when polymerization is extended beyond normal cure, the resin tends to get harder and some disintegration probably occurs within the filler. Hence, as the cure approaches the extreme, the limit of elongation of the material is reduced. However, this condition apparently has little influence upon the formability factor. Judging from the data on hand, laminated sheet material processed far beyond its normal and practical cure still retains its forming characteristics. One definite fact is established, namely, that material processed below the normal cure is undesirable from the standpoint of formability, lower physical properties and delamination. It might be well to include certain forming tests along with the acetone extraction and other tests provided for degree of cure determination, inasmuch as the defects of undercured materials are easily detected in forming.

4—Stretching jig. 5—Router jig

4



Preparation of specimens for physical tests

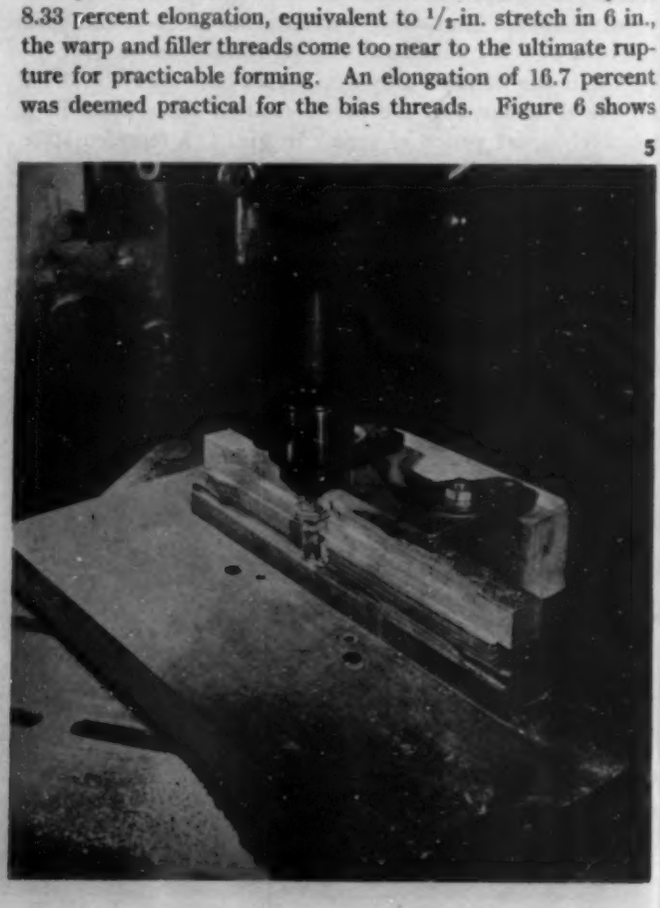
A forming operation usually consists of bending or drawing sheet material into objects having simple and compound curves or a combination thereof. Seldom are the threads lined up parallel or normal to the curvature of the shape, except in instances of simple right-angle bends. Therefore, for design purposes data of directional nature are preferable.

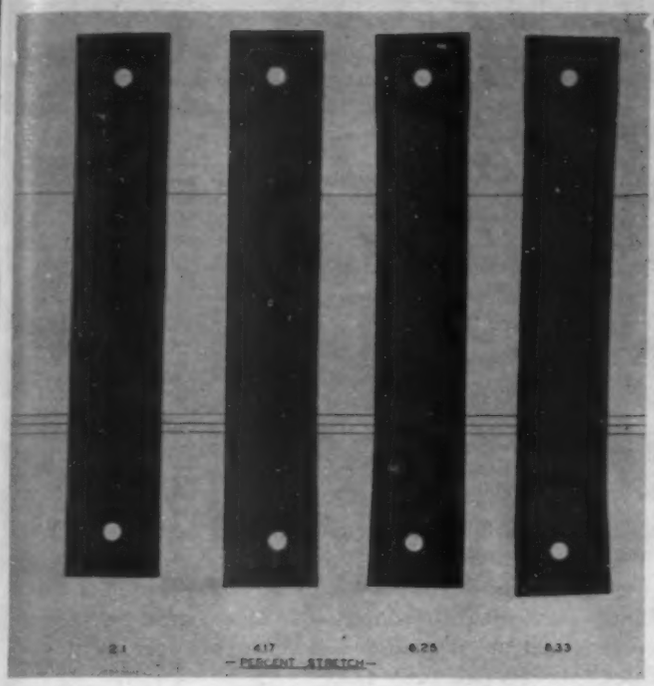
The material tested consisted of standard Grade C laminated-fabric-base sheet selected at random from stock. The fabric was 8-oz. duck with a balanced weave construction of 42 threads per inch. Phenol-formaldehyde resin made up the binder for the laminations, of which there were five.

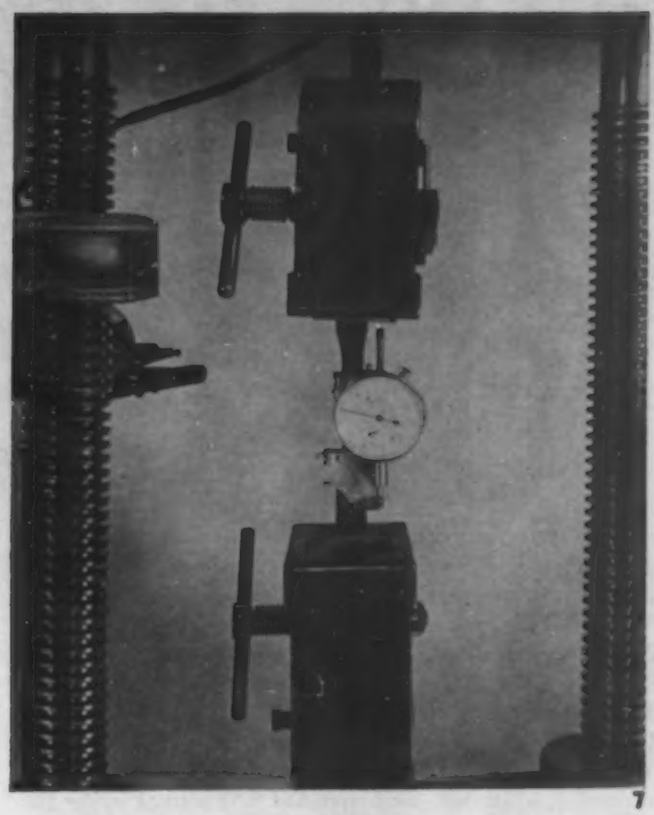
The equipment designed to prepare test specimen consisted of stretching and routing jigs. The stretching jig as shown in Fig. 4 is controlled by a hand-operated double-thread screw. Various increments of stretch are thus obtained by rotating the screw until the gage marks scribed on the specimen match the divider setting. The specimens were contoured to shape by means of router jigs as shown in Fig. 5, and the rough edges made smooth with fine steel wool.

To approximate all conditions, laminated material was prestretched in the warp direction, in the filler direction and in the bias direction. Preliminary stretching tests were conducted first to determine the approximate ultimate elongation possible in each case. It was concluded that beyond 8.33 percent elongation, equivalent to $^1/_2$-in. stretch in 6 in., the warp and filler threads come too near to the ultimate rupture for practicable forming. An elongation of 16.7 percent was deemed practical for the bias threads. Figure 6 shows

5







6—Typical prestretched specimens elongated to various increments of percent stretch. **7**—*Flexure testing unit.* **8**—*Self-aligning Templin grips*

typical prestretched specimens elongated to various increments of percent stretch. Four specimens were tested for each increment of stretch in each of the three thread directions except that only three specimens were used for each increment of stretch in the water absorption tests.

Definitions

Arbitrary 0.01 and 0.2 percent offsets were used for obtaining the proportional limit and yield strengths, respectively, of the laminated plastics. The modulus of elasticity in tension was determined by the tangent modulus method. For modulus of elasticity in flexure, the modified equation:

$$E = \frac{P'l^3}{48Iy}$$

was used where P' is assumed equal to 76 percent of ultimate, I is the moment of inertia, equal to $bd^3/12$ and y is the deflection at P'.[1]

The term "warp thread" is assigned to the thread extending along the long side of the sheet, often called the grain direction. The filler thread is taken to be normal to the warp thread. The bias direction is 45° to the filler and warp thread.

Test procedure

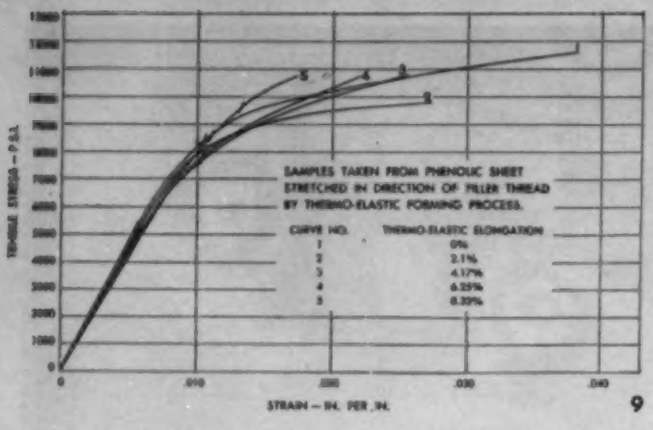
A 20,000-lb. universal testing machine was used for the tensile and shear tests. The 0 to 1000-lb. scale range was used entirely for these tests. Inasmuch as load-deflection readings for the bend test could not be suitably adapted to any of the scales provided by the machine, a flexure testing unit shown in Fig. 7 was employed.

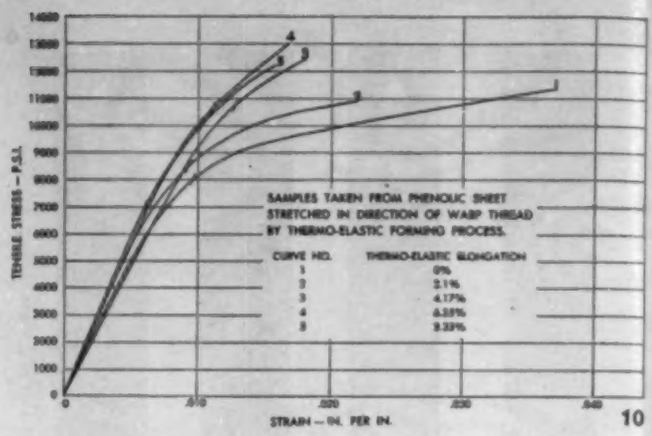
Tension tests

The tensile specimens were routed to the dimensions set forth by Federal Specification L-P-406 and inspected for uniform weave of fabric prior to testing. A strain gage of 2-in. gage length with standard dial indicator having subdivisions of 0.001 in. was clamped to the specimen installed in the self-aligning Templin grips as shown in Fig. 8. The length of the specimen between the edges of the grips was held to approximately 4.25 in. for all specimens. The deformation readings were taken at specific increments of load up to tensile failure of the specimen. The clamping pressure of the knife edges was adjusted to avoid marking or indenting the specimen.

Tensile test of specimens stretched and pulled in a filler thread direction—Figure 9 shows the stress-strain curves for group specimens 1 to 5. Each group number is an average of four

[1] "Basic Physical Properties of Laminates," by P. M. Field, MODERN PLASTICS 20, 91 (Aug. 1943).





9, 10—Tension tests on laminates NA2-4141

separate tests. Curve 1 represents test values of material as received and not processed for forming. Curves 2, 3, 4, etc., have been treated and stretched before testing. The percent stretch in each case is noted in the legend below the figure. The values for all curves from 1 to 5 are listed in Table I. Referring again to Fig. 9, it is seen that the tensile properties for material prestretched before testing indicate a general decrease in strength as compared to normal unprocessed material. The maximum drop in modulus of elasticity is shown in curve 5, which had been stretched 8.33 percent before the tensile test. As compared to the ultimate tensile stress of curve 1, curve 2 indicates a reduction of 10.5 percent.

Tensile test of specimens stretched and pulled in a warp thread direction—Unlike the curves discussed above, those representing tensile values tested in the direction of the warp thread (Fig. 10) exhibit a general improvement in physical properties. Although curve 3 tends to have less modulus of elasticity than curve 1, its ultimate stress is approximately 9.5 percent higher. Also, curve 2 has an ultimate tensile value 6 percent lower than curve 1, yet possesses a modulus 10 percent greater. Curves 4 and 5 show a marked increase over that of the unprocessed material. Stretching the warp thread increased the modulus by 15.5 percent in the case of curve 5, and the ultimate tensile strength 16 percent in the case of curve 4 (see Table I).

Tensile test of specimens stretched and pulled in a direction 45° to the filler and warp threads—Laminating materials stretched and tested on the bias reveal unusual tensile properties. Ordinarily, thermosetting laminates manifest weaker properties when loaded in the bias direction than when stretched along either the filler or the warp threads. However, it may be seen in Fig. 11 and Table I that in the case of stretched specimens this is not true. From an inspection of the ultimate tensile values recorded for all three conditions, it is to be noticed that group specimens 3 to 9 compare favorably with group specimens 1 to 5 either for the filler or for the warp directional tests. Attention is called to the fact that when a bias specimen is prestretched to 14.58 percent,

TABLE I.—EFFECT OF THERMO-ELASTIC FORMING ON TENSILE PROPERTIES OF GRADE C, TYPE II, LAMINATED PLASTIC

Specimen group No.	*Thickness before stretching, in.*	*Stretch in 6-in. gage length, percent*	*Thickness after stretching, in.*	*Elongation in 2-in. gage length, percent*	*Modulus of elasticity, p.s.i.*	*Proportional limit (0.01% offset), p.s.i.*	*Yield strength (0.2% offset), p.s.i.*	*Ultimate strength, p.s.i.*
			TENSION IN DIRECTION OF WARP THREAD					
1	.060	0	..	3.75	1,060,000	4650	7,950	11,363
2	.065	2.11	.066	2.20	1,170,000	5450	8,450	10,720
3	.061	4.17	.062	1.80	1,000,000	6800	10,750	12,420
4	.062	6.25	.066	1.75	1,170,000	6350	10,600	13,095
5	.059	8.33	.068	2.01	1,225,000	6750	10,000	12,352
			TENSION IN DIRECTION OF FILLER THREAD					
1	.060	0	..	3.80	1,000,000	4900	8350	11,782
2	.064	2.11	.065	2.87	952,000	4800	8100	9,792
3	.061	4.17	.064	2.70	923,000	4750	7000	10,883
4	.064	6.25	.067	2.24	888,000	4750	8100	10,823
5	.064	8.33	.070	1.95	857,000	6150	9600	10,642
			TENSION IN DIRECTION 45° TO FILLER AND WARP THREAD					
1	.064	0	..	3.00	970,000	4400	7400	8,075
2	.065	2.11	.067	3.35	970,000	4400	7600	8,656
3	.065	4.17	.066	4.84	1,000,000	4900	8100	10,470
4	.062	6.25	.067	4.61	970,000	4400	7600	11,097
5	.062	8.33	.064	5.61	940,000	4300	7500	13,000
6	.064	10.41	.066	4.93	1,070,000	2800	6400	11,764
7	.062	12.50	.066	5.20	940,000	3400	6500	11,300
8	.063	14.58	.069	3.71	940,000	4300	8500	14,900
9	.060	16.67	.068	3.85	790,000	4150	8000	14,150

an increase of 84.5 percent in tensile strength is obtained over the normal unstretched material. Figure 12 presents an enlarged view of bias test specimens from the unstretched and stretched material after failure.

Flexural tests

The flexural specimens were tested in accordance with A.S.T.M. D650–42T specification with the following exceptions. The specimen width was increased from $^1/_2$ in. to 1 in. to give a more homogeneous section for test. The overall length of the specimen was 5 in. and the distance between supports 3 inches. The load was applied by lead weights calibrated to plus or minus 0.005 lb. as shown in Fig. 7. The load-deflection readings were taken from the dial indicator at specific increments of loading. All specimens were deflected beyond their elastic limits to approximately 1 in., which was the maximum extension of the dial indicator. To obtain the actual load on the specimen, the spring load of the dial indicator was calculated and added to the load of the hanger and calibrated lead weights.

Flexural test of specimens stretched parallel to the warp thread and bent across the warp thread—Figure 13 shows typical stress-strain curves for stretched and unstretched specimens subjected to flexural tests. In relation to curve 1, the stretched specimens indicated by curves 2, 4, 5 and 6 lie above, whereas curves 3, 7, and 8 lie below. The general trend of these curves indicates a progressive increase in flexural properties up to and including a prestretch of 6.25 percent. The ultimate bending stress for each curve is included in Table II.

Flexural test of specimens stretched parallel to the filler thread and bent across the filler thread—The curves illustrated by Fig. 14 are in many respects similar to the stress-strain curves obtained with specimens stretched along the warp thread. The results are comparable but slightly lower than those obtained for the curves described above.

Flexural test of specimens stretched 45° to the filler and warp threads and bent across the bias—In general, the curves shown in Fig. 15 behave in a manner which appears typical for all laminates stretched in the bias direction. Occasionally, one or two curves deviate from the trend for constant improvement but, by and large, the increase in properties corresponding to various increments of percent stretch is consistent.

Shear test

The apparatus used to obtain the ultimate shear stress of fabric-base phenolic laminated specimens consists of a 1-in. diameter steel punch and die set with stripper plate. The operation of the test is simple. The plastic is placed in the shear die and the load required to shear the specimen recorded.

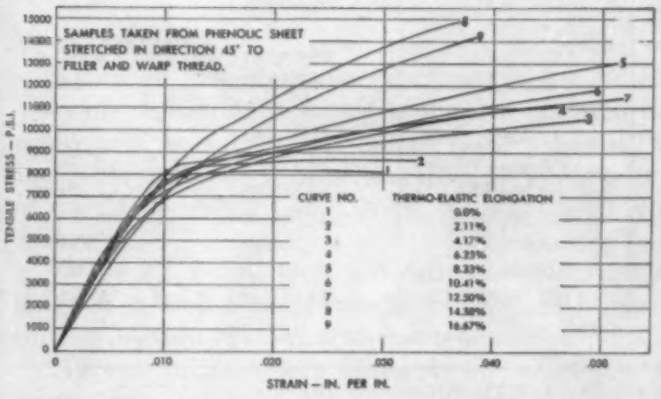
In Fig. 16 are shown curves representing ultimate shear values for test specimens at different increments of percent stretch. The material stretched along the bias offers substantially more resistance to shearing forces than does either of the other two types. In the tension and flexural tests, the specimens prestretched parallel to the filler thread revealed lower properties as compared to those stretched along the warp thread. Insofar as shear tests are concerned, the reverse is seen.

Impact test

Specimens $^1/_2$ in. wide and 3 in. long for the Charpy impact test were cut from $^1/_{16}$-in.-thick sheet material. The test was performed on an Olsen impact test machine. The distance between the supports was 1.75 (*Please turn to page 186*)

11—*Tension test of laminate NA2-4141.* **12**—*Enlarged view of bias test specimen from the unstretched and stretched material after failure.* **13**—*Flexural test of laminate NA2-4141*

11



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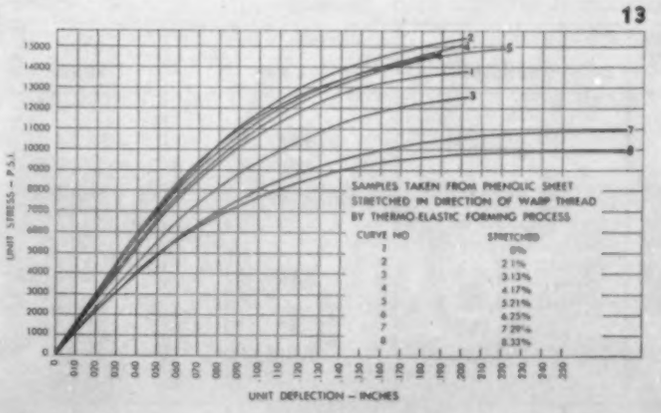
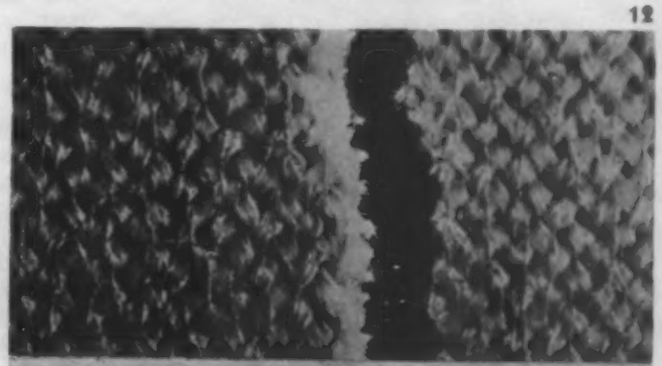
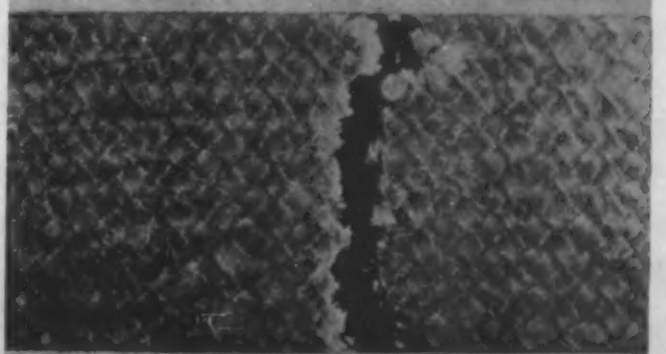


12



MAGNIFICATION 5.76 X SIZE
TENSION FAILURE OF UNSTRETCHED SPECIMEN IN THE DIRECTION 45° TO WARP & FILLER THREADS (ON BIAS)



MAGNIFICATION 5.76 X SIZE
TENSION FAILURE OF SPECIMEN STRETCHED TO 16.6% IN THE DIRECTION 45° TO WARP & FILLER THREADS (ON BIAS)

Production of synthetic resins in 1942

THIS report contains preliminary statistics of commercial production and sales of synthetic resins in 1942 in the United States. These data were compiled by the United States Tariff Commission.

Output of coal-tar resins decreased from 334 million pounds in 1941 to 284 million pounds in 1942, about 15 percent, chiefly because of a decline in the output of phthalic anhydride resins (used in paints, varnishes and lacquers) and of resins derived from phenol for uses other than casting and molding. The output of resins derived from a mixture of phenols and cresols and from cresylic acid increased slightly. In 1942, production of non-coal-tar resins rose from 104 million pounds to 143 million pounds, about 38 percent, although the maleic anhydride resin production decreased about 18 percent in that year. The production of the other principal non-coal-tar resins, polyvinyl, terpene and petroleum resins, increased markedly in 1942.

A rise in both direct and indirect military consumption was the chief cause of the considerably increased activity in the production and sales of non-coal-tar resins in 1942. In the preceding year military consumption was confined to a relatively small number of individual items. Few organic chemicals used in the manufacture of plastics were under control by allocation in 1941, but in 1942 these amounted to approximately 40 items, principally the chlorinated paraffins, formaldehyde, butyl alcohols, vinyl polymers, phenolic resins, phthalic anhydride, plasticizers, phenol, glycols, aniline, acetic anhydride, benzene, toluene, (*Please turn to page 176*)

TABLE I.—UNITED STATES PRODUCTION AND SALES OF SYNTHETIC RESINS IN 1942

Product	*Production*	*Sales*		
		Quantity	*Value*	*Unit value*
	lb.	*lb.*		
RESINS FROM CYCLIC COMPOUNDS (COAL-TAR, ETC.): TOTAL	283,844,481	241,533,228	$74,597,952	$0.31
Alkyd resins				
Phthalic anhydride	91,237,362	63,843,350	13,766,075	0.22
Derived from tar acids				
Cresols or cresylic acid	24,746,406	*	*	
Phenol:				
For casting and molding	41,679,706	40,238,528	15,058,916	0.37
For other uses	43,529,668	40,853,087	9,401,902	0.23
Phenols and cresols	37,231,604	34,558,889	23,872,540	0.69
All other	45,419,735	62,039,374	12,498,519	0.20
RESINS FROM NON-CYCLIC COMPOUNDS (NON-COAL-TAR): TOTAL	142,886,625	131,652,065	75,082,611	0.57
Maleic anhydride	7,761,180	6,881,594	1,218,582	0.18
Sebacic acid	428,836	*	*	
Urea	37,515,785	35,805,727	11,051,817	0.31
Vinyl acetal and vinyl butyral	5,972,389	5,804,110	5,427,850	0.94
All other	91,208,435	83,160,634	57,384,362	0.69
TOTAL FOR RESINS, 1942	426,731,106	373,185,293	149,680,563	0.40
TOTAL FOR RESINS, 1941	437,799,687	348,307,470	117,255,951	0.34
TOTAL FOR RESINS, 1940	276,814,363	201,099,650	59,368,339	0.30
TOTAL FOR RESINS, 1939	213,027,548	163,296,637	39,011,486	0.24

* Included in "all other."

TABLE II.—UNITED STATES PRODUCTION AND SALES OF PLASTICIZERS IN 1942

Product	*Production*	*Sales*		
		Quantity	*Value*	*Unit value*
	lb.	*lb.*		
Plasticizers from cyclic compounds: total	85,563,083	80,466,126	$18,217,663	$0.23
Plasticizers from non-cyclic compounds): total	25,032,829	21,435,886	3,708,345	0.17
Chloroparaffin	18,935,272	17,865,988	2,101,806	0.12
Dibutyl sebacate	1,724,645			
All other	4,372,912	3,569,898	1,606,539	0.45
Total for plasticizers, 1942	110,595,912	101,902,012	21,926,008	0.21
Total for plasticizers, 1941	60,948,289	55,074,096	14,153,119	0.26
Total for plasticizers, 1940	36,860,409	28,298,930	7,013,579	0.25
Total for plasticizers, 1939	29,870,759	24,369,075	5,763,427	0.24

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Technical briefs

Abstracts of articles on plastics in the world's scientific and engineering literature relating to properties and testing methods, or indicating significant trends and developments

Engineering

PHYSICAL PROPERTIES OF FIBERGLAS LAMINATED PLASTICS. C. W. Armstrong. Iron Age *152*, 51–4 (July 22, 1943). Intricate shapes and double contours are made from allyl resin saturated glass fabric by molding at 0.1 to 10 p.s.i. and at temperatures less than 240° F. The molds are simple, light in weight and inexpensive, but they must have the correct dimensions and contours. The results of tensile, compression, bending and bearing tests made on flat sheets of several samples of this type of material are reported. The specific gravity of the anisotropic materials ranges from 1.69 to 1.93; the ultimate tensile stress from 36,200 to 58,500 p.s.i.; Young's modulus of elasticity from 1,900,000 to 2,800,000 p.s.i.; the ultimate compressive stress from 19,600 to 29,000 p.s.i.; the modulus of rupture from 34,900 to 64,800 p.s.i.; and the ultimate bearing strength from 31,300 to 34,800 p.s.i. In tension, most of the load is carried by the filler material. The compressive failures were all in diagonal shear. The resin content which gives optimum tensile properties will not result in optimum bend and compression properties. Tensile tests made on specimens cut at 45° to the principal directions of the cross-stacked laminates gave ultimate tensile strength and tensile modulus values 30 to 40 percent lower than the corresponding "with grain" values. The thickness and density of the laminate are dependent on the proportion of resin and filler. Low resin content materials have high density values.

Chemistry

POLYMERIZATION OF ACRYLONITRILE AND POLYACRYLONITRILE. W. Kern and H. Fernow. J. prakt. Chem. *160*, 281 (Aug. 1942). Pure monomeric acrylonitrile is not polymerized by heat alone up to 100° C. In the presence of benzoyl peroxide, the threshold polymerization temperature is about 30° C., below which no polymerization takes place and above which polymerization is rapid. The benzoyl peroxide is consumed by the reaction. The polymers formed either in bulk or in solution are insoluble. The polymers have no softening point, begin to decompose at 350° C. and are partially crystalline.

POLYMERIZATION OF METHACRYLONITRILE AND POLYMETHACRYLONITRILE. W. Kern and H. Fernow. J. prakt. Chem. *160*, 296 (Aug. 1942). Pure methacrylonitrile does not polymerize when held at 100° C. for several weeks. Polymerization proceeds at a favorable rate in the presence of benzoyl peroxide at 60 to 65° C. The degree of polymerization depends on the concentration of the catalyst, the temperature and the reaction time. A low degree of polymerization is obtained when the reaction is carried out in solution. The products are soluble in organic solvents. Impure methacrylonitrile polymerizes without the addition of catalyst and at ordinary temperatures to give insoluble products with limited ability to swell. The polymers soften at about 115° C. and begin to decompose to monomer at about 200° C. At 250° C., an 85 percent yield of monomer is obtained.

Properties

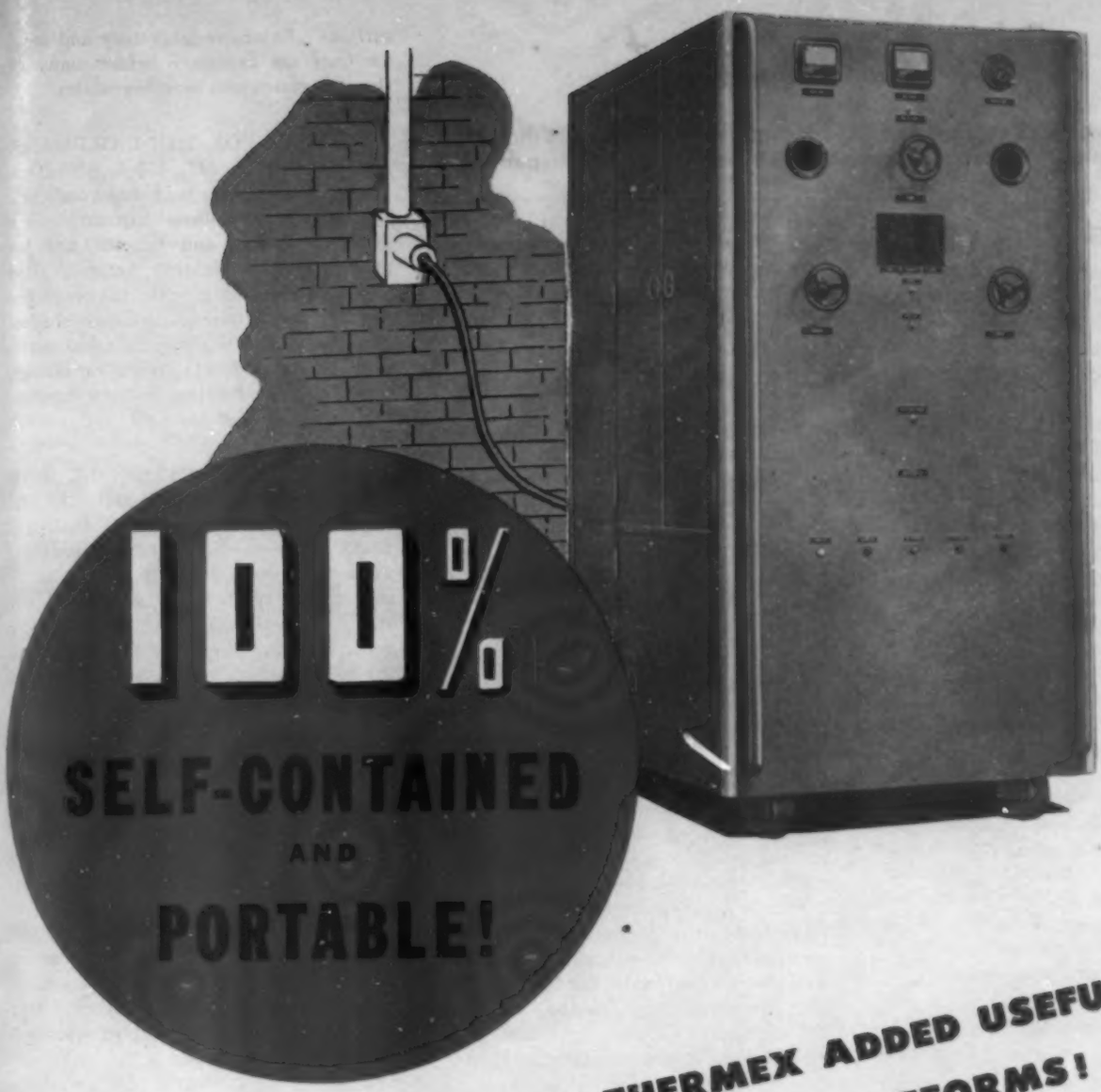
THE DIFFUSION OF GASES THROUGH HIGH POLYMERIC MATERIALS. F. H. Müller. Kolloid-Z. *100*, 355 (Sept. 1942). The permeability of films of polystyrene, polyvinyl chloride, cellulose triacetate and cellophane to water vapor, ammonia, hydrogen, oxygen, nitrogen and inert gases is reported. The permeability decreases as the molecular diameter of the gas increases; the percent decrease for the inert gases is almost the same for all the materials. The water absorption decreases in the following order: cellophane, cellulose triacetate, polyvinyl chloride, polystyrene. Permeability to water decreases in this order: cellophane, cellulose triacetate, polystyrene, polyvinyl chloride. Polyvinyl chloride is less permeable to all the gases than polystyrene. There is very little interaction between the inert gases and the sheet materials. The change in the permeability of helium with temperature obeys the theoretical exponential law. The temperature coefficient of the permeability to water depends on the change in the diffusion coefficient and the change in the solubility coefficient. Data on the permeability to water vapor of films of cellulose triacetate, benzylcellulose, polystyrene, and polyvinyl chloride between 0° and 90° C. are presented.

SYMPOSIUM ON ADHESIVENESS. I. INTRODUCTION TO THE THEORY OF ADHESION. R. N. J. Saal. Chem. Weekblad *39*, No. 8, 91 (1942). II. A SUMMARY OF PUBLICATIONS ON THE THEORY OF ADHESIVENESS. Ibid. No. 10 (1942). III. DISCUSSION. R. Houwink. Ibid. 114–115. A general review of adhesives. The nomenclature, principles of adhesion, cohesion, and the need for more rheologic data are discussed.

ELECTRICAL PROPERTIES OF COPOLYMERS OF ACRYLONITRILE AND ETHYL ACRYLATE. D. J. Mead and R. M. Fuoss. J. Am. Chem. Soc. *65*, 2067–70 (Nov. 1943). The electrical properties of a series of acrylonitrile-ethyl acrylate copolymers were measured at power and audiofrequencies in the temperature range 20 to 105° C. The copolymers have properties intermediate between those of the simple polymers; with increasing acrylonitrile content, the loss factor maximum at a given frequency increases and is displaced toward higher temperatures; simultaneously, the static dielectric constant increases from 12 to 37 in the range 35 to 100 percent acrylonitrile.

Testing

PHOTOELASTIC INVESTIGATIONS OF STRUCTURAL CHANGES IN PLASTIC MATERIALS. H. Kolsky and A. C. Shearman. Proc. Physical Society (London) *55*, 383–95 (Sept. 1943). The orientation and structural changes in 4 plastics—polythene, nylon, polymethyl methacrylate and polystyrene—resulting from the application of known stresses were investigated by measurements of the the optical anisotropy induced. The mechanism of "cold-drawing" in the case of polythene and nylon is considered in detail and the birefringence correlated with the mechanical strain. From x-ray evidence it is found convenient to divide plastic materials into 3 groups: 1) those which are already crystalline, 2) those which become crystalline on stretching and 3) those which remain amorphous. Polythene and nylon belong to the first group, but as a result of the long-chain structure of the molecules, the crystals cannot be considered to have any separate existence, and consist of small micellar groupings composed of sections of a large number of molecular chains. No photoelastic measurements were made with a material of the second type, but from the work of Treloar it is seen that natural rubber has a large positive birefringence when stretched. The other 2 plastics considered, polymethyl methacrylate and polystyrene, fall into the third group. The photoelastic investigations on these substances have indicated that small sections of the chains become aligned along the direction of stretching and orient the side groups accordingly. Increasing the temperature of the specimens decreases the extent of this orientation as a result of the thermal agitation causing vibration of these side groups.



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Plastics digest

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General

MOLECULAR STRUCTURE OF FIBERS MADE FROM NATIVE EGG ALBUMIN. K. J. Palmer and J. A. Galvin. J. Am. Chem. Soc. *65*, 2187–90 (Nov. 1943). Fibers which were made from native egg albumin by a process which involves complex formation with detergent and drawing under steam are shown to be composed of parallel bundles of polypeptide chains running parallel to the fiber axis. The peptide chains are shown to have the β-keratin configuration as is evident from the similar appearance of the x-ray patterns obtained from the albumin fibers as compared with those obtained from well oriented β-keratin. The tensile strength of the synthetic pure protein fiber is shown to be dependent upon the degree of molecular orientation and reaches a value of 38,000 p.s.i.

PLYWOOD REFRIGERATOR CARS. Ry. Mech. Eng. *117*, 352, 355 (Aug. 1943). Two hundred railway refrigerator cars recently completed for the War Department had steel underframes and superstructure frames, 1/16-in. plywood for the ceiling, 1/8-in. plywood for the sides and end sheathing, and Fiberglas insulation.

Materials

SUBSTITUTION OF PHENOL FOR CRESOL IN LAMINATED PLASTICS. L. B. Lunsford. J. Am. Soc. Naval Eng. *55*, 481–516 (Aug. 1943). The substitution of phenol for cresol in the laminates covered by Navy Specification 17P5 seems to have the greatest effect on such mechanical properties as impact strength and flexural strength; of these, the greatest effect seems to be the lowering of the impact strength. There is some reduction in the electrical properties, but this is not as serious as the impairment of the physical properties. Substitution of phenol for cresol seems to emphasize the directional properties of the laminates, both electrically and mechanically. One of 3 Type PBM laminates tested met the 17P5 requirements in all respects, and the other 2 offered distinct possibilities of early success. Type FBG is next in order of possibility of success. The substitution here appears to have been successful in one case. Third in order of possibility is Type FBE; about half of the brands submitted seemed to have distinct possibilities along this line. The least favorable, but the one in which a greater saving could be made than in any of the others, if such a substitution were possible, is Type FBM. All of the samples to date on FBM are far below present specification requirements, and much more work will have to be done with these laminates before such substitution can be possible.

MOLDING POLYVINYL ALCOHOL. C. B. Hess and J. W. Criss. Rubber Age *53*, 431–3 (Aug. 1943). Six partially hydrolyzed and 3 completely hydrolyzed types of polyvinyl alcohol are available in commercial quantities. Completely hydrolyzed types are more resistant to water. All the types are highly resistant to solvents, but are not recommended where a high degree of water resistance is required. Any durometer hardness between 10 and 100 can be obtained by varying the amount and type of plasticizer and the type of resin. Polar organic liquids are more compatible with polyvinyl alcohol than non-polar solvents. Long unsubstituted hydrocarbon chains decrease compatibility. Hydroxyl, amino, carboxyl, methoxy and amido groups promote compatibility. Polyhydroxy compounds are recommended as plasticizers. Detailed directions for the production of molding compositions are given. Dimethylol urea, a thermosetting material, is added to harden the moldings and where it is desired to reproduce detail. The compositions are molded at 80 to 160° C. and 250 to 1000 p.s.i. The powders must be dry when molded.

Molding and fabricating

HIGH-FREQUENCY HEATING IN PLYWOOD MANUFACTURE. Engineering *156*, 116–17 (Aug. 6, 1943). The manufacture of plywood by high-frequency heating is discussed. The relations between 1) moisture content of wood and dielectric constant, 2) moisture content of wood and power factor and 3) frequency and power factor are shown in graphic form.

Applications

USE OF PLASTICS IN CAR CONSTRUCTION. Ry. Mech. Eng. *117*, 320–21 (July 1943). This is a roundtable discussion on the use of plastics in railroad car construction. The consensus of opinion appears to be that 1) more information concerning the properties of plastics is needed and 2) that they will find a place in this field. Suggested uses are electrical conduits and fittings, constructional parts, panels for interiors, interior trim and moldings, wash basins, gears, pulleys, grilles, upholstery materials, curtains, shades, cushions, mattresses, buffer pads, silencer pads, window seals and wheel surfaces. Extensive laboratory and service tests are necessary before many of these suggested uses become realities.

PLASTICS FOR THE RAILROADS. Ry. Mech. Eng. *117*, 453–5, 459 (Oct. 1943). The properties of plastics and their applications in railway engineering are discussed. Actual and suggested uses for plastics include lighting fixtures, rigid and flexible tubing with the requisite fittings, seat coverings, window shades, curtains, journal box lids, electrical parts, panels, switch cabinets, freight car linings, car sheathing, flooring, battery casings, table tops and seat parts.

WATER PURIFICATION BY THE ION-EXCHANGE METHOD. O. K. Smith. Petroleum Eng. *14*, 57–60 (Sept. 1943). The results of laboratory tests made with synthetic resin ion-exchange resins and synthetic zeolites are presented. The synthetic resins have greater capacities and durability than the zeolites. In addition, complete demineralization may be accomplished by the use of synthetic resins.

NEW DEVELOPMENTS IN PLASTICS FOR AIRCRAFT. D. M. Buchanan. Aero Digest *43*, 188–92, 237 (Oct. 1943). The applications of low-pressure laminating, high-frequency heating, jet molding and transfer molding in the production of aircraft parts are described. The principles of the various developments are explained, and data on the mechanical properties of fabric, paper and glass-fiber laminated phenol-formaldehyde resins are given.

Coatings

KETONES AS SOLVENTS FOR VINYL RESINS. R. W. Quarles. Ind. Eng. Chem. *35*, 1033–43 (Oct. 1943). The ketones have made solution coatings of resins with high vinyl chloride content practical. Noncyclic ketones are adequate solvents for the vinyl chloride-acetate resins of 88 percent vinyl chloride content and apparent molecular weight of 10,000; but ketones of stronger solvent power, such as isophorone, are more practical with the high-chloride resins and with the vinyl chloride polymers. Solvent studies, by the viscosity-phase diagram method, have been used to evaluate a number of ketone solvents with Vinylite resin VYHH. The marked effect of temperature on the solutions has been studied. With certain solvents, particularly cyclic ketones, solutions of minimum viscosity are obtained with solvent-diluent mixtures. The results are interpreted as indicating selective solvation of resin by the active solvent. The order in which solvents of a mixed thinner contact the resin has a marked effect on the viscosity of the resulting solution of the vinyl resins of higher molecular weight.

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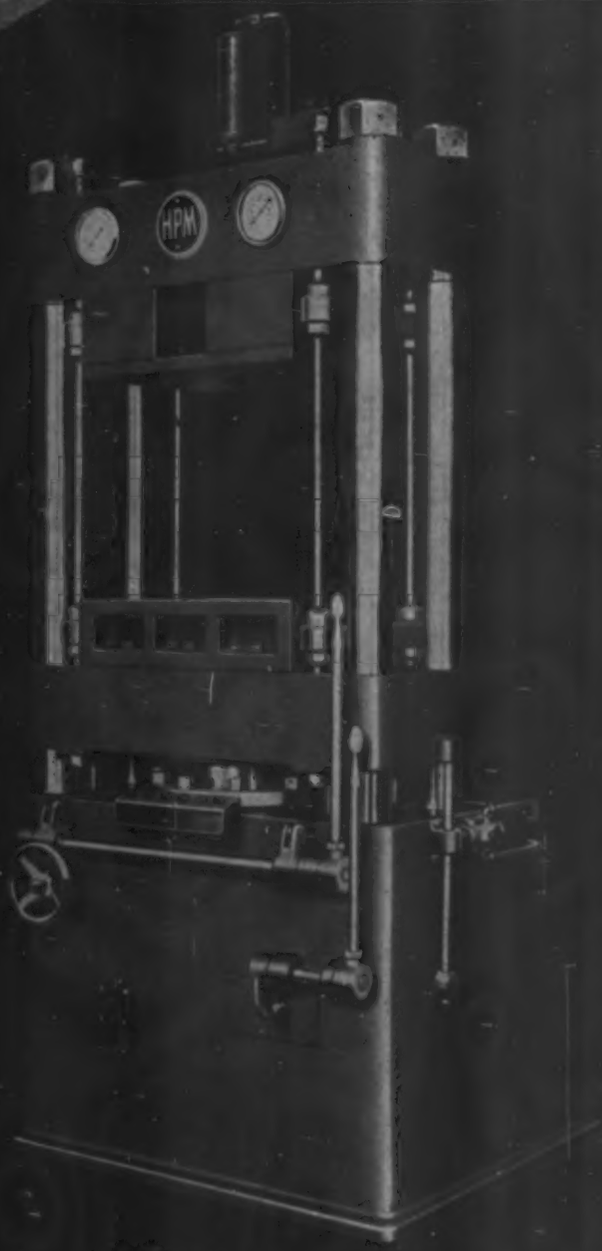

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INSTRUMENT CASE. L. T. Barnette (to Standard Products Co.). U. S. 2,331,759, October 12. An instrument case fabricated from transparent organic plastic.

SYNTHETIC RESIN. P. H. Scrutchfield (to Hercules Powder Co.). U. S. 2,331,805, October 12. A reaction product of an alcohol and a conjoint condensation product of the simultaneous reaction of a mixture of reactants which consist of an unsaturated rosinyl compound, an aldehyde, and an alpha-beta unsaturated polycarboxylic acid.

PIPE COATING. W. D. Buckingham, U. S. 2,331,824, October 12. Piping is protected against corrosion by filling with thinned "bakelite" varnish, subjecting to pressure and draining. Then air and finally steam are circulated through the system to harden the varnish.

ACID CATALYST. N. A. Shepard (to American Cyanamid Co.). U. S. 2,331,862, October 12. A composition of an acid-curing thermosetting resin, such as urea-formaldehyde, and a latent catalyst consisting of an aromatic thio-carboxylic acid ester.

CELLULOSE ETHERS. R. W. Swinehart and A. T. Maasberg (to Dow Chemical Co.). U. S. 2,331,864–5, October 12. Solubility in water of a cellulose ether is improved by adjusting water content of a solution at 50° C., cooling and maintaining below 50° C. until the mass becomes translucent, and finally drying and grinding to a powder.

ALLYL HALIDE POLYMERS. D. E. Adelson and H. Dannenberg (to Shell Development Co.). U. S. 2,331,869, October 12. A mono-olefinic halide is polymerized in the liquid phase with boron trifluoride catalyst under anhydrous conditions and in the presence of comminuted copper, platinum, palladium, iron, nickel or cobalt.

RESIN. J. F. Olin (to Sharples Chemicals Inc.). U. S. 2,331,926, October 19. The condensation product of an alkylol-urea, containing at least 2 carbon atoms in the alkylol radicals, with formaldehyde.

CELLULOSE ESTERS. H. Dreyfus (to Celanese Corp. of America). U. S. 2,331,964, October 19. Cellulose is esterified with an aliphatic acid esterifying agent in a medium which is a solvent for the primary ester formed and contains an alkylene cyclic di-ether.

COATING. W. D. Hedges, J. C. Lowman and T. J. Kerr (to Columbus Coated Fabrics Corp.). U. S. 2,331,977, October 19. A flexible film forming composition comprising nitrocellulose, butyl acetyl ricinoleate, a flexibilizer comprising a reaction product of castor oil, maleic anhydride and glycol, and diatomaceous earth as a filler.

CHLORINATED RUBBER. W. M. Kutz and G. A. Webb (to Raolin Corp.). U. S. 2,331,985, October 19. Film formation in chlorination of rubber is prevented by treating a dilute anhydrous solution of rubber with gaseous chlorine until 50–60 percent is reacted, and further chlorinating at a temperature above the boiling point of the mixture, but at a pressure to prevent boiling.

RESIN. R. A. Mathes (to B. F. Goodrich Co.). U. S. 2,331,995, October 19. The reaction product of a 2-aminothiazoline containing at least one amino hydrogen atom, in which the amino nitrogen is connected directly to the thiazoline ring at the 2-position, with an aldehyde.

CELLULOSE DERIVATIVES. L. H. Bock and A. L. Houk (to Rohm and Haas Co.). U. S. 2,332,047, October 19. Nitrogenous cellulose derivatives are prepared on water insoluble cellulosic surfaces by treating the material with a solution of a condensation product of an amino-1,3,5-triazine and formaldehyde and dimethylamine and heating.

CELLULOSE DERIVATIVES. L. H. Bock and A. L. Houk (to Rohm and Haas Co.). U. S. 2,332,048, October 19. A water soluble carboxyethyl cellulose ether is formed from cellulose by reacting cellulose with an aqueous solution of a strong base and an acrylonitrile, the reaction being continued until the reaction mixture is extensible with water to form a homogeneous solution even when acidified.

CELLULOSE DERIVATIVES. L. H. Bock and A. L. Houk (to Rohm and Haas Co.). U. S. 2,332,048, October 19. Organic solvent-soluble cyanoethyl cellulose ether and acrylonitrile are reacted in the presence of a strong base in aqueous solution.

ABRASIVE. L. Coes, Jr. (to Norton Co.). U. S. 2,332,206, October 19. An abrasive comprising abrasive grains united with a copolymer of an ester of an alkyl alcohol of not more than 4 carbon atoms, and an acid selected from the group consisting of acrylic, chloracrylic or methacrylic acids, esterified with ethylidene glycol.

ABRASIVE. S. S. Kistler (to Norton Co.). U. S. 2,332,235, October 19. An abrasive comprising abrasive grains bonded with a resin formed by condensing aniline and a triazine such as melamine or diaminotriazine and formaldehyde in the presence of a strong acid.

ADHESIVE SHEETING. R. F. Schmidt (to B. F. Goodrich Co.). U. S. 2,332,265, October 19. A pressure-sensitive adhesive sheet comprising a backing consisting of a plasticized vinyl chloride polymer and an adhesive layer consisting of rubber, polyisobutylene and melted rubber, rosin or ester gum.

RESINS. G. F. D'Alelio (to General Electric Co.). U. S. 2,332,302–3, October 19. The condensation product of an aminotriazole, an aldehyde and a halogenated amide or an aldehyde reactable acylated urea.

VIEWING INSTRUMENT. W. R. Dresser (to Patent Button Co.). U. S. 2,332,308, October 19. A device for inspecting an edge of a translucent molded article comprising a beam of polarized light which is intercepted with the object, whereby the light is diffused by an imperfection, repolarizing the diffused light and utilizing it for affecting a comparison mechanism pre-set in accordance with the light transmitted past a perfect edge.

(Please turn to next page)

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FLEXIBLE SHEET. G. L. Dorough and G. H. Latham (to E. I. du Pont de Nemours and Co., Inc.). U. S. 2,332,373, October 19. A flexible, transparent, self-supporting sheet material having a reticulated base embedded within a transparent film prepared by applying a continuous coating of a film of ethylene polymer to a reticulated open-mesh base composed of monofils of synthetic linear polyamide, heating to the melting point of the polymer and cooling in a liquid.

RESINS. I. E. Muskat and M. A. Pollack (to Pittsburgh Plate Glass Co.). U. S. 2,332,460, October 19. A polymer resulting from esterification of a polymerized mono-unsaturated monohydric lower aliphatic alcohol with a monomeric mono-unsaturated lower aliphatic monocarboxylic acid and polymerizing the ester.

ARTIFICIAL GLASS. I. E. Muskat, M. A. Pollack, F. Strain and W. A. Franta (to Pittsburgh Plate Glass Co.). U. S. 2,332,461, October 19. An artificial glass comprising a sheet of a light-transmitting rigid copolymer of a thermoplastic resin and a resin containing, in its monomeric form, at least 2 polymerizable unsaturated organic radicals, the sheet being surfaced with a layer of a polymer of a compound which in its monomeric form contains 2 unsaturated polymerizable groups separated by at least one oxygen linkage.

VINYLIDENE CHLORIDE. A. W. Hanson (to Dow Chemical Co.). U. S. 2,332,485, October 19. Filaments of a normally crystalline vinylidene chloride polymer in the supercooled state are subjected to simultaneous operations of stretching and false twisting.

CRYSTALLINE POLYMERS. R. C. Reinhardt and L. C. Chamberlin, Jr. (to Dow Chemical Co.). U. S. 2,332,489, October 19. A supercooled strand of a normally crystalline vinylidene chloride polymer is twisted while offsetting any tendency to shrink and crystallize.

CASEIN RESIN. C. S. Leonardson and D. J. White (to Borden Co.). U. S. 2,332,519, Oct. 26. A solution of casein is reacted with a urea until a viscous tacky solution is obtained and this is then treated with formaldehyde at a high temperature and a pH not below 5.5.

COMPRESSION MOLDING. A. Slatis. U. S. 2,332,537, Oct. 26. Material which shrinks during molding is compression molded in a mold with separable sections so that the molded article possesses essentially the same volume as the mold cavity.

SHEET MATERIAL. A. J. Daly, P. R. Hawtin and B. Shaw (to Celanese Corp. of America). U. S. 2,332,559, Oct. 26. Transparent sheet material is prepared on a polished glass plate by addition of layers of solution of a cellulose ester, stripping while 10–15 percent of solvent is still present and removing this while the sheet is held flat.

INJECTION MOLDING. W. R. Tucker (to Hydraulic Development Corp., Inc.). U. S. 2,332,679, Oct. 26. A machine for injection molding plastic material consisting of stationary and movable mold parts, an injection plunger and fluid pressure devices for actuating movable parts.

MOLDED ARTICLE. E. H. Goss and A. J. Hanley (to Bakelite Corp.). U. S. 2,332,792, Oct. 26. An article is molded by displacing under heat and pressure a composition comprising a continuous sheet structure of overlapping fibrous elements united by an adhesive and a fusible resin binder.

PROTEIN RESIN. C. S. Leonardson and D. J. White (to Borden Co.). U. S. 2,332,801–2, Oct. 26. Resins are prepared by heating at reflux temperature a mixture of urea, formaldehyde, and a vegetable or animal protein until a thick viscous liquid is obtained.

CASEIN PLASTIC. J. A. Parsons and W. E. Vawter (to American Plastics Corp.). U. S. 2,332,829, Oct 26. An extrusion press for preparing rods of casein plastic by forcing plasticized casein containing a flake pigment through a nozzle portion and a mottling portion.

PLASTICIZER. W. Gruber and H. Machemer (to Alien Property Custodian). U. S. 2,332,849, Oct. 26. Polyvinyl chloride is plasticized and thermally stabilized by incorporating therein an aliphatic ester of diacetoxy stearic acid.

COPOLYMERS. G. F. D'Alelio (to General Electric Co.) U. S. 2,332,895-6-7-8-9, 2,332,900–1, Oct. 26. The reaction product of an aldehyde with a hydrolyzed infusible, insoluble copolymer of vinyl acetate and dimethallyl ether; the product of the simultaneous hydrolysis and acetalization of a copolymer of vinyl acetate and diallyl phthalate; the reaction product of an aldehyde, ketone or mixture of same with a hydrolyzed copolymer of a vinyl ester; the reaction product of a hydrolyzed copolymer of a vinyl ester and an alkyd resin with an aldehyde, a ketone or a mixture thereof; the reaction product of the conjoint hydrolysis and reaction of a vinyl ester and a nitrile copolyer with an aldehyde or a ketone; the chemical interaction product of an aldehyde or a ketone with a polymerized diallyl ester of a saturated aliphatic dicarboxylic acid; and the reaction product of an aldehyde or ketone with a hydrolyzed copolymer of a vinyl ester and an unsaturated ketone.

MOLDING APPARATUS. K. L. May. and F. L. Williamson (to Bell Aircraft Corp.). U. S. 2,332,926, Oct. 26. Apparatus for molding softened plastic sheet material into dish-shaped objects comprising a heating means and a turntable.

COATING. C. D. West (to Polaroid Corp.). U. S. 2,332,958, Oct. 26. A light-polarizing device comprising a transparent supporting element, a dichroic light polarizing surface on the support consisting of a thin film of a plastic such as polyvinyl alcohol or a polyvinyl acetal in which the molecules of a polarizing material are oriented, a protective layer of the plastic and an abrasion-resistant coating.

VINYL COMPOUND. M. R. Lytton and R. J. Taylor (to American Viscose Corp.). U. S. 2,332,974, Oct. 26. A copolymer of vinyl chloride and vinyl acetate containing chlorine in addition to that present in the simple copolymer.

ABRASIVE. N. E. Oglesby, C. F. Reilly and V. W. Gilbert (to Behr-Manning Corp.). U. S. 2,333,034–5, Oct. 26. Coated abrasives are prepared with a cellulosic web, a synthetic resin adhesive and abrasive grains.

RUBBER HYDROHALIDE. C. A. Thomas and H. E. Morris (to Monsanto Chemical Co.). U. S. 2,333,214, Nov. 2. Rubber hydrohalide is produced by subjecting rubber to intimate contact with a complex addition product of dioxane and a hydrogen halide until the product is substantially a monohydrohalide.

POLYVINYL HALIDE. H. Tucker (to B. F. Goodrich Co.). U. S. 2,333,280, Nov. 2. A composition consisting of polyvinyl chloride, a plasticizer, and the hypochlorite of an alkali metal, an alkaline earth metal, or a tertiary alkyl.

RESIN. K. E. Ripper (to American Cyanamid Co.). U. S. 2,333,390, Nov. 2. A resin formed by reacting formaldehyde with a mixture of dicyandiamide and melamine under alkaline conditions at 50° C.

UREA-FORMALDEHYDE RESIN. C. R. Stock (to American Cyanamid Co.). U. S. 2,333,396, Nov. 2. A non-yellowing molding composition consisting of a urea-formaldehyde resin, cellulose pulp and titanium dioxide.

The following patent was given an incorrect number on p. 118 of the October issue:

LAMINATES. C. Dreyfus. U. S. 2,325,668–9, August 3. Composites comprising metal laminated with plastic, and wood laminated with plastic.

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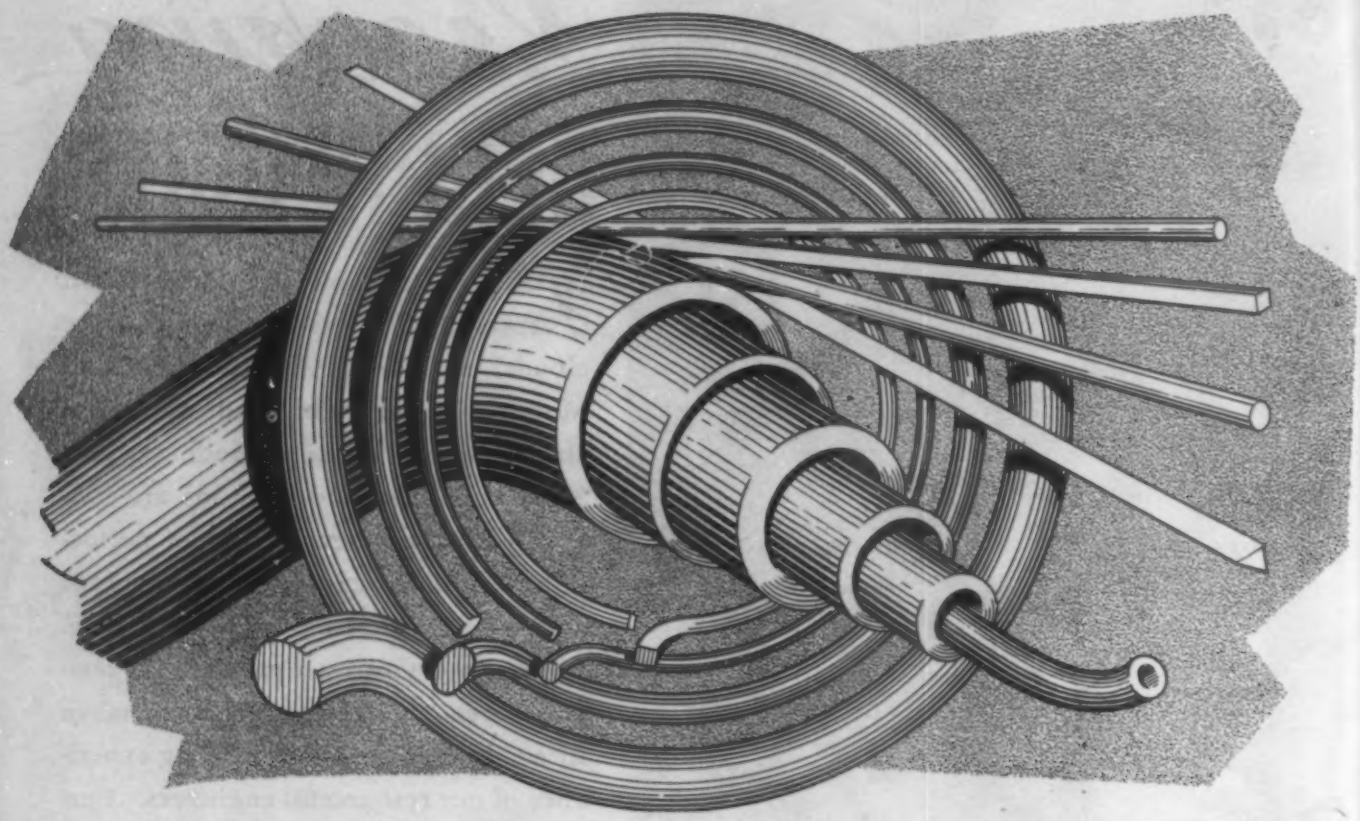

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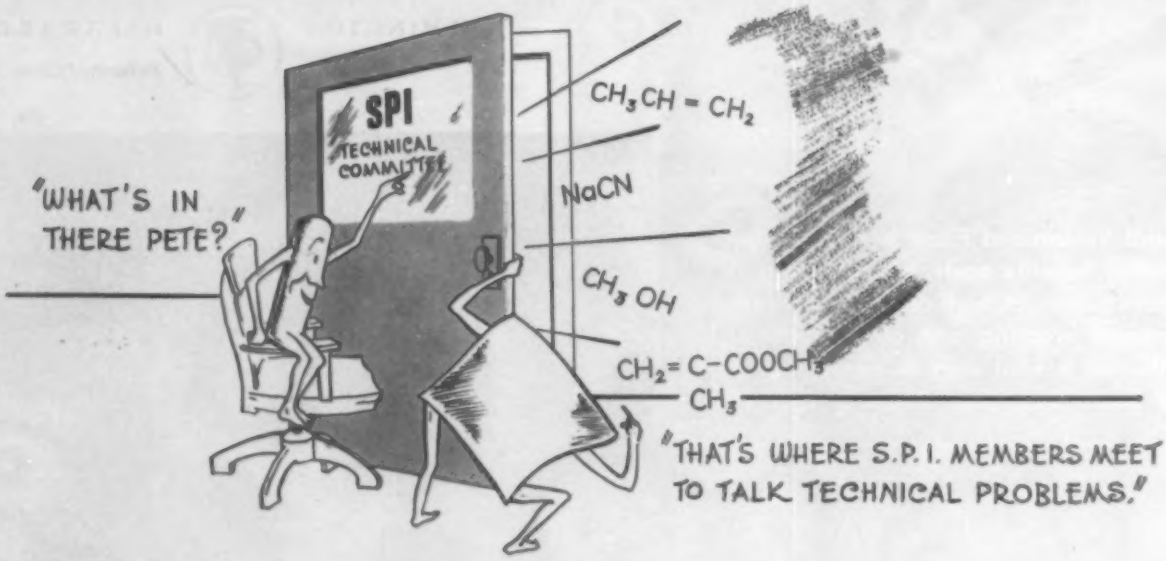

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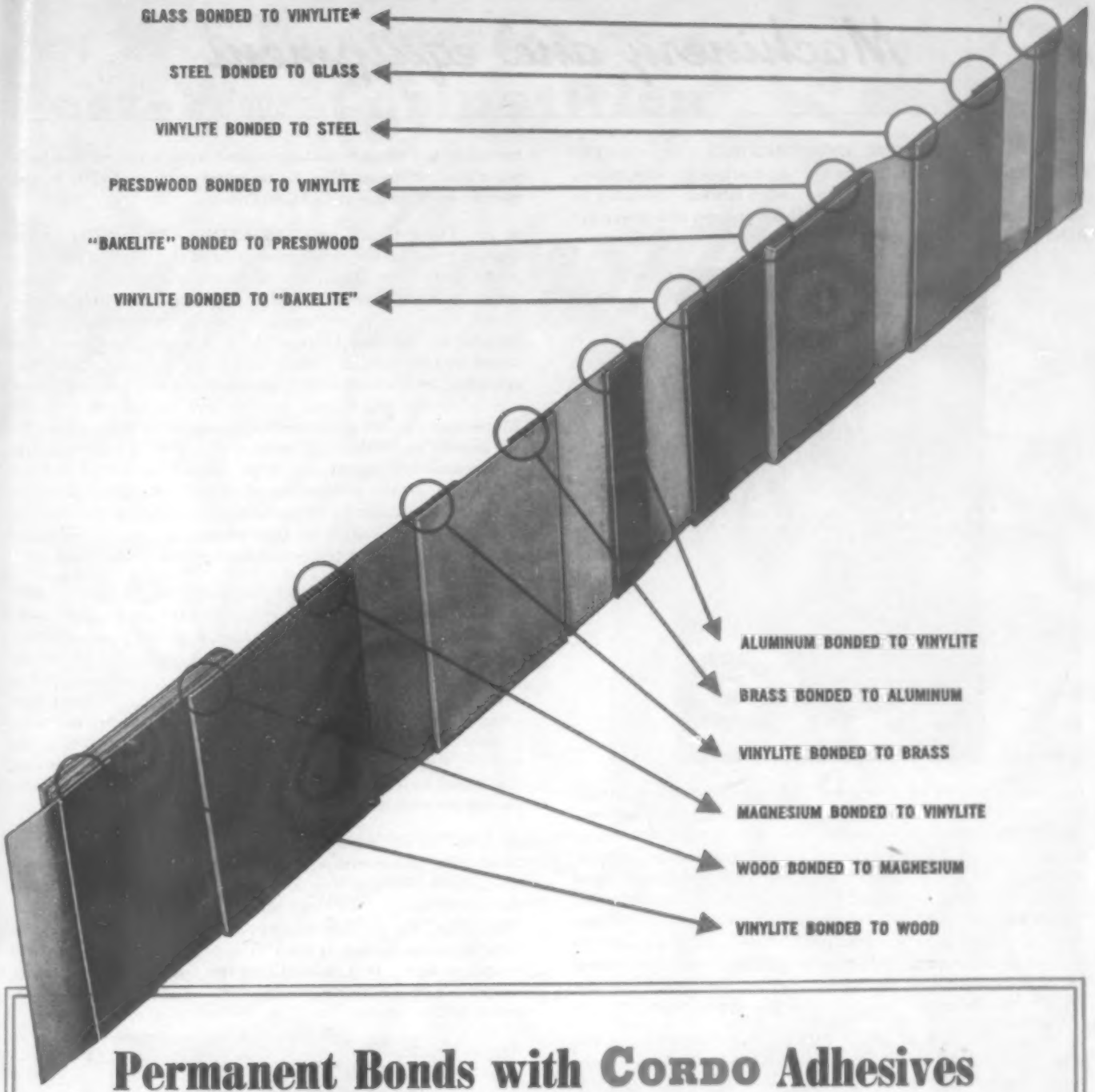
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Our research laboratories can, perhaps, help in solving your present or post-war bonding problems. Please give full details including pressure and baking facilities.

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CORDO CHEMICAL CORPORATION
(*Formerly* CORROSION CONTROL CORPORATION)
34 Smith Street, Norwalk, Connecticut
INDUSTRIAL COATINGS • FINISHES • LACQUERS • ADHESIVES

CORDO

Machinery and equipment

★ INDUSTRIAL OVEN ENGINEERING CO., CLEVELAND, Ohio, has developed a new wind-up machine for wire, paper, tapes of various kinds, textiles and coated fabrics. Designed to meet strict Army-Navy specifications for uniform and concentric finishes in impregnation and coating of wire and cable insulation

the unit is said to be the only one of its kind on the market. Available in 2 standard sizes, the machine is complete and self-contained with combination variable speed and hydraulic synchronizing equipment. By arrangement of adjustable counter-weights, wire tension can be varied from a few ounces to hundreds of pounds. The unit comprises a dismountable reel stand, multi-warp large-diameter capstans, constant but variable tension mechanism and an adjustable level winder. It is available in higher operating speeds for extrusion windup in the use of rubber or synthetic insulation materials. Unwind stands also are supplied in standard sizes for semi-automatic operation.

★ A NEW AUTOMATIC PRESS, DEVELOPED ESPECIALLY for rapid and accurately controlled production of powdered metal parts and dry-mix ceramics, now is offered by F. J. Stokes Machine Co., Philadelphia, Pa. This machine is understood to compress pieces up to 3 in. diameter at a rate of 15 to 45 per min. and to apply pressures up to 20 tons from both top and bottom. Pressure adjustments may be made while the press is in operation. Features of the press are said to include separate ejection and compression levers; screw adjustment for compression; a twin disk clutch and combined brake for instantly starting and stopping the machine even under full compression load; variable-speed drive for production with materials and parts of varying characteristics and size; and adjustable gibs for maintenance of close accuracy in punch and die alignment.

★ COMBUSTION CONTROL CORP., CAMBRIDGE, MASS., has recently introduced an electronic feedwater control for maintaining automatically constant boilerwater levels and guarding against low-water hazards. This device, marketed under the name of "Fire-eye Type P 156N," is used with a probe fitting which may be mounted parallel to the water column or directly on the boiler and is wired to the electronic control. Three probes within the fitting, mark boiler feedwater pump on and off levels and a low-water danger point. The top and middle probes determine the high and low levels at which the feedwater pump is turned on and off to maintain constant water level. These feedwater controls are supplied for boiler pressures up to 300 lb. and operate on 115 or 230 volts AC 60 cycles.

★ A HYDRAULIC PRE-HEATING, MOLDING AND chilling press for the rapid production of thermoplastic printing plates, instruction plates, control panels and Vinylite matrices, rubber printing plates and thermosetting matrices has been designed by Stereotex Machinery Co. of Stamford, Conn. Manufactured by Baldwin Locomotive Works, the machine is produced in two sizes, a 300-ton and a 500-ton unit. The self-contained hydraulic system is operated by 4-way solenoid valves and is controlled by push buttons and an automatic timer. Either high pressure gas or electricity may serve as the source for the heating system and an accuracy of ±2° F. is maintained by the automatic temperature control. The lower platen and top platen of both the pre-heating press and the chilling press are vertically adjustable by hydraulic means in such a way that for certain work the top platen may assume the position normally occupied by the lower platen and support the sliding plate.

★ THE PRODUCTION OF DRIER COMPRESSED AIR with consequent prevention of water damage to pneumatic equipment are two of the advantages claimed by the Niagara Blower Co., New York City, for their improved equipment for cooling compressed air. The new system uses the evaporative cooling principle to obtain temperatures said to be 10 to 25° lower than those possible with the conventional coolers and to produce compressed air which, the company claims contains 1/2 to 3/4 the amount of water present in other compressed air cooling systems. Air, drawn by a fan through a water spray across coils containing the compressed air is the cooling medium.

★ CONTINENTAL MACHINES, INC., MINNEAPOLIS, Minn., has introduced a new low-cost continuous band filing machine for file broaching operations on metals, alloys, plastics, fibres and wood. Marketed under the name of the "Do-ALL Band Filer" the machine is equipped with 12 different types and sizes of file bands, ranging from 1/4 in. to 3/8 in. wide in ovals, half rounds or flats. It is claimed that this size range makes it possible to file even intricate jobs to tolerances of less than .001 inch.

Internal filing operations may be performed by unsnapping the file bands and threading through the work. "Speed master" infinitely variable speed pulleys make it possible for the operator to vary speed pulleys cutting speed from 50 to 250 r.p.m.

For War Production and Post-War Competition

Mold Automatically

WAR-PROVED through the production of thousands of different plastics parts to the most exacting government specifications — the Stokes Completely Automatic Molding Machine offers post-war economies no executive can afford to overlook.

For it permits him to make the plastics parts he needs, as he needs them, right in his own plant by a completely automatic method requiring only a minimum of skilled labor, and at savings which many times have paid for the entire investment in a matter of months.

AUTOMATIC MOLDING SAVES

Automatic Molding saves labor . . . machines are completely automatic.

Molding time is saved . . . cycles are reduced 50% or more in many cases.

Molding material is saved . . . 8% to 10% or more.

Mold cost is low . . . only few cavities are used.

Tool steel and tool-makers' time are saved . . . molds require only a fraction of the steel and labor that go into a large conventional mold.

Output per cavity is high . . . up to 10,000 or more moldings per week.

Parts are produced as needed. There are no large inventories, therefore . . . no inventory losses.

There are no human errors to contend with . . . parts are of highest quality, always.

LET US MAKE A COST STUDY FOR YOU

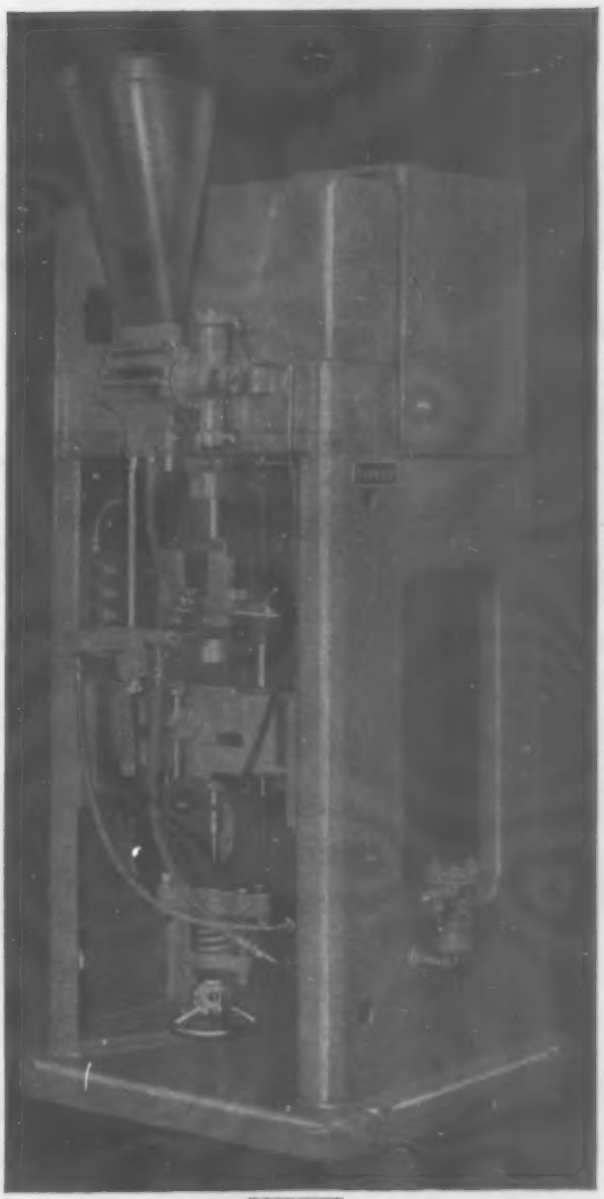
It is none too soon to investigate Automatic Molding for many parts that will go into your post-war products. Stokes engineers who pioneered Automatic Molding have helped many manufacturers apply it to the solution of their individual problems.

Use this special Consulting Service . . . to tell you quickly whether parts are suitable for automatic molding, to accurately estimate costs, and to help you in automatic mold design.

F. J. STOKES MACHINE COMPANY

5934 Tabor Road Olney P. O. Philadelphia 20, Pa.

Representatives in New York, Chicago, Cincinnati, St. Louis
Pacific Coast Representative • L. H. Butcher Company, Inc.



PATENTED

F.J.Stokes MOLDING EQUIPMENT FJS Est. 1895

Publications

Write directly to the publishers for these booklets. Unless otherwise specified, they will be mailed without charge to executives who request them on business stationery. Other books will be sent postpaid at the publishers' advertised prices.

Micrometrics: The Technology of Fine Particles

by J. M. DallaValle

Pitman Publishing Corp., 2 W. 45th St., New York, 1943

Price $8.50 **428 pages**

Matter progresses in size from molecules to colloids to microscopic particles to visible particles. This book specializes in the behavior phenomena and analytical control of fine particles in the microscopic and relatively small macroscopic sizes. These particles range in diameter from 10^{-1} to 10^{5} microns, i.e., approximately 0.000004 to 0.4 inch. It is readily apparent that the scope of the book covers a great many important industrial processes. Sieving, packing of particles, fine grinding and dust problems are typical of these. In addition, the author presents a critical survey of methods of measurement of particle size, shape, surface and distribution, a discussion of physical and chemical properties of small particles and a 40-page bibliography of selected references. The book is a unique and commendable contribution to engineering literature. G.M.K.

Chemistry and the Aeroplane

by Vernon J. Clancey

The Ronald Press Co., 15 E. 26th St., New York, N. Y.

Price $2.25 **176 pages**

This is one in a series of books which covers each of the sciences underlying aeronautics in a manner that makes its application readily understood. The text is intended to provide some link between theory and the practice of flight, and to show that the role of chemistry in the development of the aeroplane is part of a general dynamic process. A chapter is devoted to a discussion of the chemical composition of various plastics and a prediction of plastics future role as it relates to the aeroplane.

★ DOUGLAS T. STIRLING CO. HAS JUST ISSUED A booklet, "Industrial Design—The Key to Post War Products," describing its new laboratory at 500 Fifth Ave., New York City, under the direction of Donald R. Dohner and J. Gordon Lippincott, industrial designers. The 8-page leaflet answers the question, "What is industrial design?" and the 7 basic steps in new product design—market analysis, new product ideas, new materials and methods, product development, engineering, finance and merchandising—are discussed.

★ SAV-WAY INDUSTRIES, PRODUCTS DIV., DETROIT, Mich., has published a pamphlet on "Precision—What Does This Word Mean in Your Plant?" Application pictures are used to describe the new set of master setting and checking rolls for precision tools and inspection devices. Use of these disks is said to eliminate time wasted in building up combinations of gage blocks, and inaccurate checks caused by wear on micrometer anvils. The gages range from .100 to 2.000 diameter and are lapped to "X" gage tolerance (.00004 to .00008 in.).

★ THE VIRGINIA POLYTECHNIC INSTITUTE HAS publish d a bulletin on the "Strength Properties of Red Spruce from West Virginia" by E. George Stern. The last 3 pages of the book are devoted to a description of the V.P.I. Wood Research Laboratory compiled by Earle B. Norris. Small specimens cut from 6 bolts of 3 trees were used in the tests which indicated that red spruce has strength properties similar to or better than other spruce or Sitka spruce. These findings indicate that this wood may be of service as a substitute, on aircraft and other structures, for Sitka spruce which is very scarce at the present time. Illustrations and charts are used throughout the booklet to give point to the text.

★ THE LATEST PAMPHLET ON COATED ABRASIVES issued by Behr-Manning, Div. of Norton Co., Troy, N. Y., is limited to the presentation of basic information. After a condensed treatment of the 3 basic materials from which modern coated abrasives are made—abrasive grain, backing and bond—brief descriptions are given of the coating process, technical skill for technical tools, coated abrasives in use and how to order.

★ ELECTRICITY IN THE CHEMICAL INDUSTRY," General Electric Co.'s newest bulletin (GEA-3710) illustrates and briefly describes equipment used in the chemical industry for generating, transforming and distributing power; for material handling; for processing in the electro-chemical and thermo-chemical fields; and for operation in dusty atmospheres and in hazardous locations. Various instruments for electrical measurements also are discussed.

★ "SYMPOSIUM ON PAINT" IS A COMPOSITE OF seven papers presented at the Buffalo spring meeting of the American Society for Testing Materials. The articles deal with protective concealment, blackout, emulsion and luminous paints, drying oil and fatty acid development, surface coating of opaque pigments and surface coating of calcium carbonate extenders. The text is well illustrated with photographs and charts. Copies of this publication can be obtained from A.S.T.M. Headquarters, 260 South Broad St., Philadelphia 2, Pa., at $1.00 per copy.

★ LESTER-PHOENIX INC., CLEVELAND, OHIO, IS distributing a bulletin describing the company's line of fully automatic injection molding equipment. The text is supplemented by cut-away drawings of various parts of the machines. This leaflet, No. 8, is designed for insertion in the Lester loose-leaf catalog.

★ SPEEDMASTER CO., DES PLAINES, ILL., HAS RE-cently revised its engineering manual describing the company's Speedmaster, a double groove single-belt variable speed pulley designed to provide stepless, infinitely variable speed change while in operation. After a discussion of the reason for infinitely variable speed, typical applications and the "what" and "why" of the pulley, the rest of the manual is devoted to a detached description of various types of Speedmaster pulley, their application and operation.

★ A 24-PAGE BOOKLET EMPHASIZING THE IMPOR-tance of safe, economical and easy loading devices has been issued by the Towmotor Corp., Cleveland, Ohio. Photographs and charts are used throughout the text to show each operation of Towmotor control.

★ THE NATIONAL SAFETY COUNCIL, INC., IN CHI-cago, Ill., has published its annual Accident Rate Pamphlet covering 1942 accident experience in the chemical field. The 14-page booklet uses charts and tables to show the percentage rate of accidents in some of the larger branches of this industry.

extruders of rods • tubes • shapes • tapes • elastics
Synflex compounds meet and surpass the most exacting requirements of the electrical and aviation industries. Of particular interest is Synflex FT22—a versatile rubberlike synthetic. This formulation developed in our own laboratories is used as sheath, sleeving insulation, communications and mechanical rubber goods. Synflex FT22 has a high dielectric and tensile strength and resists heat to 194°F.
Other available Synflex formulations: Synflex FT10 for lowest temperature uses. Synflex FT11, excellent where transparency, low temperature resistance and good dielectric are required.
Synflex tubings are stocked in continuous lengths from B&S #24 (.021 I.D.) to 2.000" I.D. Special sizes and shapes upon request. Inquiries invited. We will be glad to submit complete test methods, data and samples.
RIGID ... to FLEXIBLE ...
SYNFLEX
INDUSTRIAL SYNTHETICS CORPORATION
60 WOOLSEY STREET, IRVINGTON, NEW JERSEY

Washington round-up

Current news, Government orders and regulations affecting the plastics industry, with analysis of the plastics situation as prepared by R. L. Van Boskirk, our Washington editor

New AA-1 rating for MRO parts affects molds and manpower

Molders and laminators now may extend an AA-1 rating for MRO materials under Amendment 2 to CMP Regulation 5, provided that they do not exceed a cost of $500. Molds are classified as MRO, but they must also be authorized under L-159 on application form PD-741. Amendment 2 to CMP 5 permits WPB to grant a rating up to AA-1 for molds that are authorized under L-159. The big point in this situation is that molders can now get an AA-1 rating in the most important cases and thus expedite delivery.

Under CMP Regulation 5, paragraph K(4), a rating assigned on a PD-741 application under L-159 is the only rating applicable to the purchase or manufacture of that mold regardless of a rating from any other possible source. A manufacturer may get an AA-1 rating from the Army on an order for something like razors, but he can not extend that same AA-1 rating for construction of a mold if the Chemicals Division of WPB assigns an AA2x rating for molds from which to make razors. Now WPB has the authority to grant up to an AA-1 rating for the most important applications, but it still has the duty of deciding which are the most important.

"What about molds for less essential civilian items?" The trade is beginning to learn that WPB is currently approving molds with low ratings such as AA-5 for the manufacture of end products that are down low on the essentiality list. The purpose of WPB's liberality is to help fill gaps in tool room production. Heretofore molds were not approved unless plastics raw materials were being allocated for the particular items which were to be processed. Now WPB will give a low rating, say AA-5, for a mold that is to be used for less essential needs some time in the future. The mold maker will produce it when he has the time or material and the user can set it aside for the day when he may have the raw material to use in it. It should be pointed out that if these low essentiality molds are approved, there is no assurance that raw material may be made available to use in them.

Another interesting angle of the new AA-1 rating for MRO parts is that plastics molders and laminators now are on Schedule I under CMP Regulation 5, which indicates high essentiality. They should use this high rating to impress local War Manpower Commission and Selective Service Boards with the importance of the plastics industry. If the industry can obtain a top rating for its machinery, then why not top rating for its employees?

Unfortunately there is no nation-wide formula for coordinating WMC critical manpower lists with WPB's priority ratings. In Boston the area director of the WMC checks each company to find out its WPB priority rating. In that particular area a high WPB priority rating is meaningful, and there is a good chance that WMC will consider a firm's high rating as prima facie evidence that workers in that firm are essential. The evidence helps to secure preference on referals and deferments for employees, and to freeze workers on the job. In other areas WMC uses other methods to designate critical plants which should receive labor priority.

WPB priority ratings do not always tell the complete story. Chemicals, for example, are allocated instead of rated. There is no present procedure for tying in allocations with manpower essentiality although in some cases WPB furnished WMC with lists of critical chemical plants—Buffalo, Akron, Hartford and Detroit. Nevertheless everyone knows that the chemical and plastics industry is hard pressed for manpower in other areas, and no such list is used despite the critical situation in chemicals.

Revised ethyl alcohol allocation order permits increased small orders

Revision of Order M-30, which covers the allocation of ethyl alcohol, has been amended by WPB to reduce the amount of paper work in administration of the order. This action permits purchasers to acquire 7900 gal. of ethyl alcohol in any calendar quarter without WPB authorization. The previous limit was 3500 gallons.

Small order exemption clauses of the order also have been changed and for the same purpose—reduction of paper work. No appreciable increase in the amount of alcohol involved is expected as a result of this action.

Labor management committees

One hundred typical statements from responsible management officials on the operation of their Labor-Management committees are contained in a 38-page booklet just issued by War Production Drive Headquarters. The book is entitled, "100 Industrialists Report." Copies may be obtained from War Production Drive Headquarters, 3014 Municipal Center Bldg., Washington, D. C.

New Quartermaster research committee

A new committee to work on new types of films made from synthetic elastomers has been set up. Its 2-fold purpose is to attempt to improve films now in production and to find improved films for various Quartermaster purposes.

Black markets in plastics

OPA officials now admit that a troublesome situation has developed in plastic materials' black markets. Enforcement officials have been put on the job and arrests or citations may follow soon. Most complete information is available on the situation as it applies to vinyl and methacrylate scrap dealers. However there is evidence that the black market also is working in all thermoplastic molding powders and in film scrap.

Here is a typical example: When Bill Moates, a customer, notifies Joe Doakes, a scrap dealer, that he wants 1,000 lb. of unground scrap, Joe bills Mr. Moates for 1,000 lb. at the ceiling price for unground scrap—21 cents. But a day or two later he puts another bill into the mail for ground scrap which bills Mr. Moates for the same 1,000 lb. of material at perhaps 10 or 15 cents a pound which is well below the ceiling, and thus may avoid immediate detection. But Mr. Moates is paying far more than the ceiling price for his 1,000 lb.—in some cases it is reported that the price has been doubled.

The following is an example of a practice which seems to be most common among the scrap dealers who sell thermoplastic molding powders. The scrap dealer says "My ceiling price is 53 cents. I can't bill you for more, but if you want to get this material, slip me $300 in cash right now. I'll see that you get it, and I then can bill you at the regular ceiling price."

OPA officials point out that a buyer of over-ceiling priced goods is just as guilty in the eyes of the law as the dealer who sells it. They also stress the fact that it is just as illegal to offer to sell above the ceiling as it is to actually complete the deal. Respectable plastics operators are requested to lend every aid toward the liquidation of this black market operation which could easily give the industry an unpleasant reputation although it is believed that the offenders are all fringe operators. Plastics producers and processors can expedite eradication of this evil by exposing any facts or evidence reaching their attention in connection with violations of this type. (*Please turn to page 158*)

PLASTICS For Fun . . .

◆ One of a series of "Blue-Prints For Tomorrow" by Egmont Arens, Industrial Designer

WHEN the canteen counters of today are replaced by the toy counters of tomorrow, children's eyes will pop at the wonderful new playthings in plastics. To set Columbia readers thinking about plastics "for fun" . . . seriously . . . here are some amusing ideas suggested by Designer Arens.

A marching soldier top with a wind-up spring in its hat. Husky plastic letters to fill a child's fist. Beads that string together to make necklaces, bracelets, dolls or animals. Punch and Judy doll with replaceable "character" heads. Tumbling dog with felt ears. Humpty Dumpty unbreakable at last.

From toys to tableware, from combs to cosmetic containers, Columbia's demonstrated versatility in molding plastics for volume production commends itself specially to those who plan ambitious goals in the mass-markets of the future. That's why Columbia has its own "Blueprint for Tomorrow", calling for a vast increase in its custom molding capacity by building and equipping a new super-plant when peace returns.

BUT TODAY Columbia's facilities for injection molding are devoted to the war effort. Prime or secondary contractors on war or other essential products will find us wholeheartedly co-operative to the extent of available capacity. If you have an essential problem, call or write Columbia.

COLUMBIA

PROTEKTOSITE CO., Inc. Carlstadt, N. J.

cp custom plastics

Methyl methacrylate affected by sodium allocation

Metallic sodium, an essential chemical in the production of high-octane gasoline manufacture, and in the manufacture of methyl methacrylate, was placed under allocation by WPB on Nov. 15, 1943.

The expanding aviation program made this action necessary in order to assure ample supplies for military purposes. Steps have been taken to provide new sodium production by improvements to present facilities. But even when these are completed, the output will not be sufficient for all civilian purposes after military requirements have been met. Allocation will be operated through the customary forms—WPB-2945 and WPB-2946.

Important plastics raw material production figures

The Chemicals Division of WPB recently made public for the first time in recent years, monthly production figures for a select group of chemicals. This information will be made available regularly in the future and will cover the following inorganic chemicals: calcium carbide, chlorine, caustic soda, sulfuric acid, potash, superphosphates, copper sulfate and oxygen. Among the organic chemicals for which information will be made available are butyl alcohol (normal), phenol, aniline, phthalic anhydride, acetic acid, acetic anhydride, acetone and isopropyl alcohol. Monthly production data for carbon black also will be given.

Publication of these production figures should prove of value to the chemical industry in determining some of the trends that exist in important products. It is intended that as time goes by, this list may be expanded.

U. S. Production of Certain Chemicals

Chemical	*August 1943*	*July 1943*	*August 1942*
Calcium carbide, short tons	54,133	51,549	41,381
Chlorine, gas including liquid, short tons	133,650	132,579	114,499
Butyl alcohol, normal, lb.	11,544,202	9,088,935	10,609,613
Phenol:			
synthetic, lb.	15,196,664	16,216,228	11,456,149
natural, lb.	2,153,776	1,945,450	1,946,383
Aniline, lb.	8,527,746	8,319,254	8,904,401
Phthalic anhydride, lb.	9,566,720	8,481,154	7,574,739
Acetic acid:			
natural, lb.	4,177,241	4,178,333	4,188,945
synthetic, lb.	28,687,355	27,194,262	22,926,475
Acetic anhydride, lb.	39,253,153	38,499,598	36,501,115
Acetone, lb.	29,074,704	25,932,761	26,444,083
Formaldehyde, lb.	43,625,839	44,036,162	31,826,287
Isopropyl alcohol, lb.	35,029,271	32,930,653	28,957,677

OPA price regulations on plastics under study

A proposal to simplify OPA price regulations on plastics by substituting one new regulation for the present multiple regulations was laid before the Plastics Industry Advisory Committee today at its first meeting in the Regional OPA offices, Empire State Building, New York City. This suggestion, taken under consideration by the Committee, would provide a formula whereby manufacturers themselves can price new plastic articles. This would eliminate the present requirement that prices on such new articles must be set by the Washington Office of OPA.

Charles Munroe, Chief of the Transportation Section and Parts and Sub-Assemblies Section of the Machinery Branch, Washington, D. C., submitted the proposal which will eliminate plastics from General Maximum Price Regulation Supplementary Order 229, Maximum Price Regulation 188 and Maximum Price Regulation 136 in favor of one overall regulation. Prior to the session, the committee held an organization meeting at which D. S. McKenzie, sales manager, Plastics Div., General Electric Co., was elected chairman; V. C. Petersen, vice-president of R. D. Werner Co., vice chairman; and George K. Scribner, president of Boonton Molding Co., secretary and treasurer.

War training programs

This article was specially prepared for Modern Plastics *by Flora G. Orr, Information Manager, Bureau of Training, War Manpower Commission.*

ALMOST overnight the plastics industry turned from pre-Pearl Harbor manufacture of civilian goods to production of implements of war. To meet the challenge of mass production, output of all existing installations has been stepped up. In this expansion program, however, lack of properly trained personnel has been one bottleneck.

In this emergency, many plastics companies, like other war production industries, have turned for training assistance to the short, college-level courses in the Engineering, Science, and Management War Training Program of the War Manpower Commission. Since 1940, ESMWT, as this program administered by the U. S. Office of Education is familiarly called, has been paying the cost of instruction in intensive courses in engineering, chemistry, physics, and production management at recognized colleges and universities. This instruction serves industry in 2 ways: by offering training in vital subjects necessary for the up-grading of employed persons, and by conducting basic training in essential techniques for new personnel.

Loss of trained men to the armed services has further complicated the problem of meeting ever-growing quotas in plastics production. To replace these men, women have responded nobly and still are needed in ever-increasing numbers. But first they require qualifying training. Women and girls with appropriate backgrounds of high school or college training are being recruited for ESMWT courses in plastics. They have proved their ability to master this training and, when actually placed in jobs, have shown competence in performing men's work in the chemical laboratories and design departments.

The need for ESMWT plastics courses is determined either by local surveys in which representatives of industry, Government and education are consulted, or by direct requests for training assistance from the plastics manufacturers themselves.

Many institutions participating in the ESMWT program have received requests for special plastics courses. As a typical example, the University of Akron was asked by the Goodyear Aircraft Corp. to give a course entitled "Plastics in Engineering," for selected personnel of their company. To meet a continuing demand, Pennsylvania State College has repeated the course, "Production, Properties, and Utilization of Plastics," 5 times in such centers as York, Reading, Pittsburgh and Scranton.

To date, more than 5000 persons in the plastics industry have received ESMWT training in college classrooms, at off-campus extension centers and in the factories themselves. In all, 29 colleges and universities have organized courses relating to plastics. Typical subjects are "Plastics," "Plastics Techniques," "Plastics Production and Fabrication," "Plastic Molds and Tool Design" and "Wood Plastics and Plywoods." Both full-time courses, requiring 40 or more hours of attendance each week, and part-time courses, meeting 2 or more evenings a week, are offered. The duration for part- and full-time courses is from 8 to 16 weeks.

Courses leading to employment in the lower levels of subprofessional work in plastics production and utilization are open to high-school graduates with credit for a year or more of chemistry. A full year of college chemistry is usually required of those aspiring to more technical and specialized jobs. For the most advanced courses, leading to professional jobs, college degrees in chemistry or engineering are prerequisite.

Employers desiring assistance in the training of technicians and professional personnel for plastics industries should communicate with ESMWT institutional representatives at colleges and universities serving their industry. ESMWT regional advisers also are ready to help and advise concerning the establishment of suitable training in any of the 12 War Manpower regions. Names and addresses of the institutional representatives and the regional advisers in any center may be obtained from the Director of ESMWT, U. S. Office of Education, Washington, D. C.

WHAT DO YOU THINK?

This is the first of a series of Monsanto Plastics advertisements which will appear in several leading business magazines this year. As you can see at a glance, it breaks what is probably the most basic law of advertising and salesmanship. It focuses attention, not on the virtues of the products it offers potential users, *but on their shortcomings!*

Briefly, here are our reasons for taking this unconventional approach:

It seems obvious today that the public is sold to the hilt on the part the plastics industry will play in the bright new postwar world to come. In fact, many an industry would turn handsprings for a place in the limelight half as prominent as ours.

But ever since Sunday feature writers first began to rhapsodize over the coming Plastics Age, many of you with a personal stake in the sound future of the plastics industry have been fearful of the effects of *over*-selling the public. You fear that the truly amazing advances our industry has made will pale into disappointing insignificance beside the rosy visions that have been painted. You are afraid that plastics will be assigned jobs they are not yet ready to fill—and that when they fail on those jobs, all of us will share the blame.

In short, many of you feel that it is time someone started applying the brakes to public optimism about plastics.

This is our way of applying the brakes.

Later advertisements in this series addressed to business executives will take the same frank, straight-from-the-shoulder approach to plastics and the jobs they can and cannot logically be expected to fill in postwar products. Of course, we expect Monsanto to benefit—but we also hope that these advertisements will have a healthy effect on the future of the entire industry.

Are we on the right track?

Will you give us your frank reactions? In a brief note—or a five-page letter—whichever you need to express your opinions?

There are some jobs plastics can't fill

A plastic frying pan would be light . . . easy to handle . . . easy to clean. It would also be a sleek and colorful addition to the postwar kitchen.

But once you tried to fry your breakfast bacon in a plastic frying pan—you'd never buy another.

In fact, the chances are you would look with suspicion on any plastics products for some time to come . . . which explains Monsanto's frankly selfish reasons for pointing out the *limitations* as well as the many virtues of plastics.

Plastics are bright and colorful, appealing to the eye and warmly pleasant to touch. They are light in weight, yet surprisingly strong. When combined with other materials, such as paper, cloth, wood and even glass they add many useful properties. They can often be formed into intricate and complicated shapes at substantial savings in production time and cost. They are resistant to chemicals and to atmospheric attack. They are amazingly versatile, doubling in one form for rubber, in another for aluminum and in still another for glass.

But plastics are sensitive to very high temperatures. They cannot match the surface hardness of glass. They are not at their best when merely substituting in a product designed for other materials. To get the most from plastics you usually have to start your design from scratch . . . and work closely with someone who *knows* plastics, yet can also grasp your problems.

This is plain talk, but we think it's the kind of talk you want to hear when you look at plastics as possible raw materials for your products. For our *mutual* benefit, it's the kind of talk you *will* hear from our plastics consultants if you come to us for advice. MONSANTO CHEMICAL COMPANY, Plastics Division, Springfield, Massachusetts.

★ ★ ★

The Broad and Versatile Family of Monsanto Plastics

(Trade names designate Monsanto's exclusive formulations of these basic plastic materials)

LUSTRON (polystyrene) • SAFLEX (vinyl acetal) NITRON (cellulose nitrate) • FIBESTOS (cellulose acetate) • OPALON (cast phenolic resin) RESINOX (phenolic compounds).

Sheets • Rods • Tubes • Molding Compounds Castings • Vuepak Rigid Transparent Packaging Materials.

MONSANTO PLASTICS

SERVING INDUSTRY . . . WHICH SERVES MANKIND

In the news

FRANK W. WARNER

★ FRANK W. WARNER HAS BEEN APPOINTED CHIEF engineer of the Plastics Divisions of General Electric Co., Pittsfield, Mass., according to an announcement by William H. Milton, Jr., manager of the divisions. The position formerly was held by Henry M. Richardson. Mr. Warner has been connected with the Plastics Divisions since 1931 and has been in charge of engineering development of all divisions since the spring of this year. G. A. Gustafson has been appointed manufacturing manager of the same divisions.

★ A TECHNICAL MEETING OF THE SOCIETY OF Plastics Engineers which was held on Dec. 3 in Chicago, was devoted to a discussion of a unified classification system of plastics that is being worked out by the Technical Committee. E. B. Woodman of Durez Plastics & Chemicals, Inc., said that the system was intended to be flexible, simple and of such a permanent nature that it would apply to present plastics as well as to those that might be developed in the future. A. H. Voss of Western Electric Co., and a member of the Molding Technique Committee, agreed wholeheartedly with the idea of this system. J. O. Reinicke of Barnes & Reinicke and a member of the Product Design Committee, also supported the idea of identifying plastics materials with a definite and permanent numbering system. C. N. Sprankle, discussion chairman, expressed his belief that the proposed system would be of great help to the individual consumer of plastics products.

★ FRANK SANDERSON MacGREGOR HAS BEEN APpointed general manager of Electrochemicals Dept., E. I. du Pont de Nemours & Co., Inc., Wilmington, Del. Mr. MacGregor, assistant general manager of the department since Feb. 1942 will succeed Dr. E. A. Rykenboer who is retiring because of ill health.

★ FROM THE PLASTICS CLUB OF SAINT LOUIS, MO., word is received that the club is now almost 6 months old. At the initial meeting last July the following officers were elected: president, Charles T. Clark of the Pioneer Corp.; treasurer, Herman H. Buergler of Brass and Copper Sales Co.; secretary, Dorsey C. Wright of Shell Oil Co. Harry Pancoast of Continental Diamond Fibre Co. was appointed chairman of the membership committee.

★ THE 1944 WILLIAM H. NICHOLS MEDAL OF THE New York section of the American Chemical Society has been awarded to Dr. Carl Shipp Marvel, professor of organic chemistry at the University of Illinois, for outstanding contributions to the structure of vinyl polymers used as synthetic plastics.

★ HARRIET B. JOSEPHS, for the past four years managing editor of MODERN PLASTICS, has been granted an indefinite leave of absence to be with her husband, presently stationed at an Army camp in the Middle West. Her many friends in the industry will be glad to know that Miss Josephs plans to rejoin the staff when she returns to the city.

★ TENNESSEE EASTMAN CORP. AND HOLSTON Ordnance Works, which it operates under a contract with the War Department, were on Dec. 6 presented with the Army-Navy Production Award in ceremonies held at Kingsport, Tenn. The presentation was made by Major General Charles T. Harris, Jr., Commanding General, Aberdeen Proving Grounds, who, after briefly reviewing the Company's industrial history, said in part:

"When war broke out, due to this background of experience and technical knowledge...your Government requested the Tennessee Eastman Corp. in Nov. 1941 to undertake certain experimental work leading up to a new and secret explosive. The Company then successfully undertook pilot plant manufacture of the explosive itself....This success led to a contract on June 6, 1942, between the U. S. Army Ordnance Department and the Corporation under which the latter was charged with the responsibility of designing the production equipment and operating the Holston Ordnance Works. Remarkable progress was made in the completion of the large plant, until today, while further expansion is still under way, the men and women of Holston Ordnance Works are daily producing tons and tons of an explosive which is making Hitler and Hirohito regret the day they began this war."

★ THE CLEVELAND CHAPTER OF THE SOCIETY OF Plastic Engineers was organized at a meeting held at the Hotel Carter, Cleveland, Ohio, on Nov. 19. Phil Roff of Bakelite Corp. and W. B. Hoey of Plastic Processes, Inc., were in charge while A. R. Morse of Reed-Prentice Corp., acted as temporary chairman. Following the dinner meeting R. J. Metzler of Hercules Powder Co. spoke briefly on the use and applications of ethyl cellulose. He presented samples to illustrate various applications. For the rest of the evening Mr. Hoey, chairman of the national technical committee, discussed the reasons for the formation of SPE and its aims. He also mentioned the society's plan for chapters in Pittsburgh, Dayton and Buffalo. Future meetings will be held at the Cleveland Engineering Society on the last Friday of each month. In view of the large Akron attendance plans were made to hold meetings periodically in that city. A temporary governing committee of 9 men was set up to further organize the new chapter into committees and directive groups. This committee includes A. R. Morse, chairman; Robert H. Kitner, American Hard Rubber Co.; C. F. Linn, Watertown Manufacturing Co.; O. W. Marsh, General Industries; R. O. Osborn, Hoover Co.; Frank Prendergast, Apex Electric Co.; L. S. Shaw, Plastic Industries; Eugene Slingluff, B. F. Goodrich Co.; L. H. Williams, Ohio Rubber Co.

★ J. HANDLY WRIGHT HAS BEEN MADE DIRECTOR of the Dept. of Industrial and Public Relations, Monsanto Chemical Co., St. Louis, Mo., according to an announcement of Charles Belknap, president. For the past four and a half years Mr. Wright has served as executive vice-president of the Associated Industries, of Alabama.

★ EUGENE O'HARE HAS BEEN APPOINTED DIRECTOR of technical service of Casein Co. of America, a division of Borden Co., which is engaged in the manufacture of casein and synthetic resin adhesives used in the fabrication of plywood and laminated war products for the Army, Navy and Air Corps. Before joining

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plastics have about a million uses today. Perhaps the honor of starting the second million will fall on your product—but you must know whether or not your plastic will do the job before you invest your money. ★ The United States Testing Company, Inc., has the equipment and experience to test your plastics, physically or chemically, and deliver the kind of answers you want.

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the Borden organization in August 1942, Mr. O'Hare was employed by several government agencies in the capacity of chief technical designer, also working as a consultant on wood products design and manufacture.

★ THE ANNUAL MEETING OF THE CANADIAN SECtion, Society of the Plastics Industry, will be held at the Royal York Hotel, Toronto, on Tuesday, Jan. 25, and will feature a special conference of the plastics industry in Canada. A large display of molded plastic products drawn especially from the membership of the Canadian Section will be augmented by a selection of plastic applications originally appearing in the MODERN PLASTICS display which has been widely shown in the United States.

A. E. Byrne, president of the Section, is chairman of a special conference committee in charge of the program. Other committee members are: J. L. Burnie, Monsanto Chemical Co., Ltd., exhibits and samples; I. G. Goddard, Can. General Electric Co., Ltd., Plastics Div., speakers and program; I. Wintrob, M. Wintrob & Sons, and C. Bewick, Canadian Industries, Ltd., Plastics Div., joint chairmen on hotel arrangements and registration; K. H. Braithwaite, Duplate of Canada, Ltd., and M. W. Davidson, Bakelite Corp. of Canada, in charge of reception and hospitality; A. W. Bennett, Can. General Electric Co., Ltd., and H. Flynn, Monetary Times Publishing Co., printing, badges, etc.; and C. C. Fuller, Percy Hermant Co., Ltd., publicity.

An imposing panel of speakers, representative of the fine cooperation existing between Canadian and U. S. members of the SPI, will deliver a series of interesting papers throughout the morning and afternoon sessions. James Neal, Norton Laboratories, Inc., Lockport, N. Y., will be the luncheon speaker, taking as his subject "Twenty Years a Molder." B. K. Sandwell, the editor of *Saturday Night*—one of Canada's most influential weekly newspapers—will be the guest speaker at the annual banquet.

During the morning and afternoon sessions the following papers and speakers will appear on the program: "Vinyls in the Automotive Industry," by G. Shaw, Union Carbide & Chemical Co.; "Plastics from Wood, and for Wood Improvement," by R. V. V. Nicholls, Dept. of Chemistry, McGill University; " 'Mosquito'—a Design in Wood," by R. B. McIntyre, project engineer, De Haviland Aircraft Co. of Canada, Ltd.; "Melamine Resins—Their Properties and Applications," by C. J. Romieux, Sales Mgr., Plastics Div., American Cyanamid Co.; "Development of Postwar Plastic Products," by Morris Sanders, architect and industrial designer; "Metal Plating Plastics," by R. R. Dickey, manager, Plastics Div., Monroe Auto Equipment Co., Monroe, Mich.; and a paper on the latest advances in electronic heating of plastics.

During the conference the annual meeting of the Canadian Section of SPI and election of officers for 1944 will be held. Conference and exhibits will be open to all members of the SPI and guests. Applications for registration may be obtained from Mr. I. Wintrob, M. Wintrob & Sons, 30 Duncan St., Toronto.

★ TWENTY-SEVEN MANUFACTURERS OF SYNTHETIC elastomers will participate as an industrial advisory panel in a new project getting under way at Polytechnic Institute of Brooklyn under the auspices of the National Research Council Committee on Quartermaster Problems, to perfect present methods of preserving the Army's food supplies, of protecting soldiers' metal equipment from rust and to provide lighter and more durable personal equipment. Capt. William H. Aiken, U. S. Army, will serve as liaison officer between the Institute's research group and participating industries. The first meeting of the advisory was held on Dec. 6, and attended by plastics experts from many parts of the country. Subsequent meetings will be held every 3 or 4 months.

★ THE DEVELOPMENT OF A NEW GRADE OF NITROcellulose having greater solubility in alcohol has been announced by Hercules Powder Co., Wilmington, Del. Lacquers made with this SS nitrocellulose are claimed to possess the properties of standard nitrocellulose lacquers, including quick-dry, flexibility, toughness, durability and chemical resistance.

★ SPECIALLY APPOINTED COMMITTEES ARE WORKing on details for the Second Annual Conference of the Pacific Coast Chapter of the Society of the Plastics Industry. During the past year this Chapter, which includes Washington, Oregon and California, has more than doubled its membership and the coming conference is expected to be well attended. It will be held on Monday and Tuesday, Feb. 21 and 22, at the Ambassador Hotel, Wilshire Boulevard, Los Angeles. Speakers cannot be announced at this time but plans call for a talk by a Washington member of the WPB, who will outline the plastic material situation for next year. Heatronic equipment, Pacific Coast development for aircraft, plastics after victory, are other subjects which appear on the schedule. A round-table discussion of after war procedures will take place after luncheon on Tuesday.

The Conference Committee chairman is Robert A. Cooper, Plastic Die & Tool Corp. Other committee chairmen are: Exhibits, Clark Richards, Jr., of Monsanto Chemical Co.; Entertainment, B. L. Murman of Wilson & George Meyer & Co.; Speakers, R. B. Gutsch of Plastic & Die Cast Products Corp.; House Arrangements, Harold Gandy of Modern Plastic Co.; Invitations, Dave Swedlow of Swedlow Aeroplastics, Inc.; Publicity, Frank Wilcox of Wilcox Plastics Molding Co.; Reception and Hospitality, Dwight C. Hirsh of Allied Plastics Co.

Those planning to attend are urged by the committee to make reservations with Dwight C. Hirsh, 6235 South Manhattan Place, Los Angeles 44, at the earliest possible moment. Hotel accommodations are not plentiful and reservations should be made well in advance. A check for $7.50 should accompany each reservation made. Those wishing information about exhibits should get in touch with Clark Richards, Jr., whose address is 605 West Olympic Blvd., Los Angeles 15.

★ WILLIAM H. PEACOCK, OF THE TECHNICAL Service staff of Calco Chemical Div., American Cyanamid Co., will conduct a course in the Evening Textile High School, 351 West 18th St., New York, N. Y., this winter. Subjects covered by the lectures will include color matching, terminology, judging color effects, Munsell, Ostwald, and other color standards and measurement of color.

★ ESTABLISHMENT OF A NEW UNIT FOR THE MANUfacture of butadiene and styrene at Kobuta, Pa., signalizes an important addition to the nation's synthetic rubber production program. This plant, which was built by Koppers Co., Engineering and Construction Div., for the Defense Plant Corp., is operated by Butadiene Div. of Koppers United Co. under contract with the Rubber Reserve Co. The location of the new unit in the Pittsburgh industrial area, close to sources of coal and its chemical byproducts as well as to a centralized supply of alcohol, has greatly facilitated the delivery of basic chemical components used in the plant's manufacturing processes. Annual production is rated at 37,500 short tons of styrene, 80,000 short tons of butadiene. The unit is responsible for one-seventh of the entire basic chemical requirements of the synthetic rubber program.

★ THE ARMY-NAVY "E" STAR AWARD WAS GIVEN Dec. 4 to Worcester Moulded Plastics Co. by the War Department in recognition of the high calibre of its work for the Chemical Warfare Service during the past year.

★ F. G. SCHRANZ, VICE-PRESIDENT, BALDWIN Southwark Div., Baldwin Locomotive Works, Philadelphia, Pa., has announced the appointment of John C. Graf as sales manager of the hydraulic press and special equipment department. Mr. Graf first became associated with the company in 1915; since 1925 he has held the position of New England sales manager.

★ GASTON F. DUBOIS, VICE-PRESIDENT OF MONsanto Chemical Co., St. Louis, Mo., will receive the Perkin Medal of the American Section of the Society of Chemical Industry in recognition of his outstanding work. Mr. DuBois, who will be the 38th chemist to receive the medal, has been with Monsanto Chemical Co. since 1904 and has contributed

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- the sound, straight-thinking engineering of Chicago Die Mold Manufacturing Company
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to practically every technical development of this company and its subsidiaries. The medal will be presented to DuBois by Prof. Marston T. Bogert of Columbia University at a reception and presentation held at Hotel Commodore, New York City, on Jan. 7.

★ THE NOV. 15 MEETING OF PLASTICS ENGINEERS Association, held at the Yale Club in New York City, was presided over by Chris Groos, president. The guest speaker, Gilbert Shaw of Carbide and Carbon Chemicals Corp., discussed "Vinyl Resins—History and Applications."

★ BECAUSE OF ILL HEALTH, GEORGE H. BOEHMER of Celanese Celluloid Corp., will retire temporarily on Feb. 1 from his position as manager of the company's Washington, D. C., plastics division, a post which he has held since October 1942. Boehmer retired as general sales manager of Celluloid Corp. in 1939, but was called back in November 1940 to set up the Washington office.

★ CORROSION CONTROL CORP., NORWALK, CONN., wishes to announce that as of Jan. 1, 1944, its corporate name will be changed to Cordo Chemical Corp. No changes have been made in management and control.

★ ZENITH PLASTICS CO., CLEVELAND, OHIO, HAS announced the appointment of William E. Taylor as general manager. Mr. Taylor has long been associated with the plastics industry in such companies as Resinox Corp., Consolidated Molded Products Corp. and Firestone Rubber and Latex Corp., Plastics Div.

★ HERMAN R. THIES, FORMER ASSISTANT MANAGER of the Goodyear Research Laboratory, has been appointed manager of the Goodyear Tire & Rubber Co.'s newly organized Plastics and Chemical Sales Div. at Akron, Ohio. Robert D. Vickers, R. S. Sanders and Eileen Marshall also will be members of the new division which will confine its activities to the plastics and associated fields.

★ BENJAMIN J. LAZAN, CHIEF ENGINEER OF SONNtag Scientific Corp., Greenwich, Conn., an affiliate of Baldwin Locomotive Works, was awarded the Alfred Noble Prize for 1943 for the most outstanding research work in the field of engineering. The prize which was presented on Dec. 1 at the annual dinner of American Society of Mechanical Engineers held at the Hotel Pennsylvania, New York City, was awarded for research work described in Mr. Lazan's paper on "Some Mechanical Properties of Plastics and Metals under Sustained Vibrations."

★ VICTORY PLASTICS CO., HUDSON, MASS., HAS been given the Army-Navy Production Award for high achievement in the production of war materials.

★ A PROCESS FOR PRODUCING CELLUFLEX, A PLASticizer of the tricresyl phosphate family, from petroleum acids has been developed by Celanese Corp. of America, New York, N. Y. As a result of this development, this plasticizer for synthetic rubber, plastics and flexible coatings now is available in greatly increased quantities.

★ THE ARMY-NAVY PRODUCTION AWARD WAS presented on Nov. 12 to the men and women of Parkwood Corp., plastics laminators, Wakefield, Mass.

Sorry!

★ IN DESCRIBING THE NEW 16-OZ. DE MATTIA INjection molding machine on page 144 in our December issue, we incorrectly attributed the designing of the unit to the Brosites Machine Co. The machine was designed by De Mattia Machine and Tool Co., Clifton, N. J., and it is distributed by Brosites Machine Co., Inc., New York, N. Y.

Speeches of the month

★ A NEW FIELD OF CHEMICAL LEND-LEASE WHICH promises to produce more sugar from the same cane or beets, and cheaper vitamins from brewery wastes was the subject of a recent talk by Dr. Robert J. Myers of Resinous Products & Chemical Co., before the Northeastern Section of American Chemical Society. This system of exchanging one ion, or electrically charged particle, for another by means of "ion exchange resins" gives the chemist control over the composition of many substances and has many practical applications. Although the principle itself is not new, Dr. Meyers explained, the synthetic resin exchanges have the advantage that unlike the previously available exchange materials, they do not disintegrate but can be used for almost indefinite periods. Among the uses for Amberlite ion exchange resins, he mentioned the recovery from wine residues of commercially valuable tartrates for munitions and photographic materials, and the salvage from mine and industrial wastes of much-needed metals. He also pointed out that these synthetic ions are serving to achieve greater purity in drugs, dyes, chemicals and foods and are used in a water-conditioning process which is much less expensive than distillation.

★ THE URGENT NEED FOR GREATER FAMILIARITY on the part of engineers and designers with the chemical and physical properties of plastic materials was clearly brought out by W. F. Bartoe at the Cleveland meeting of the Society of Automotive Engineers held on Nov. 10. The paper, which was prepared jointly by Mr. Bartoe and Dr. D. S. Frederick, representatives of Rohm & Haas Co., discussed a number of these characteristics with regard to their bearing on engineering design. Four important considerations in the design of plastic applications which are not covered by ordinary tables according to the speaker, are: the effect of the nature and mode of application of stress; the amount of permanent dimensional change with time; the required service temperature range; the previous history of the material; and the effect of temperature on its physical properties. Mr. Bartoe presented specific data on the transparent thermoplastic Plexiglas which had been prepared in the Rohm & Haas laboratory for the guidance of aircraft designers and engineers.

★ NEW HORIZONS FOR THE PLASTICS INDUSTRY and resulting new conveniences for homes, offices, schools and factories were envisioned in a speech delivered Nov. 9 by Fred W. Wentker, manager of Electronic Apparatus Section of RCA Victor Div., Radio Corporation of America, at a meeting of the Plastics Club of America in the Hotel Pennsylvania, New York City. Through new RCA electronic devices which are used to generate heat in raw material preforms before molding, greater speed of production of molded plastic products has been achieved with marked improvement in quality. Mr. Wentker also indicated the possibility that the higher curing efficiency of electronic heating methods may make it possible to use less costly plastic compounds for products where great strength is not of first importance. He discussed the method of procedure followed for electronic heating of metal and plastics, and explained their advantages over older methods. He also described the uses of the RCA electronic seaming machine in joining sections of thermoplastics or thermoplastic-coated fabrics and of the RCA spot gluer for the temporary bonding of thin veneers of wood in the manufacture of shaped plywood forms.

★ "THE ERA OF PLASTICS" WAS THE SUBJECT OF Business Forum Radio Broadcast No. 35 given under the sponsorship of the Commerce and Industry Association of New York over Station WMCA on Nov. 10. Mr. Thomas Jefferson Miley, secretary of Commerce and Industry Association, acted as moderator of the discussion. The three speakers were W. H. MacHale, Plastics Division, American (*Please turn to page 188*)

INJECTION MOULDING
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Plastic Parts of Every Description
ST. LOUIS PLASTIC
MOULDING COMPANY
SAINT LOUIS
MISSOURI
DIES AND TOOLS
PLASTIC FABRICATION
PIPE SARAN TUBING
MOULDED PARTS

Conservation exhibit in Washington

IN many respects, war is the greatest promoter of human endeavor ever devised. The viciousness of mortal combat forces men to make superhuman efforts to produce material that will help to outfight and outlast an enemy who is making the same effort to do the same thing.

Spurred on by this struggle for survival, an intelligent people will strive to make the best use of their most available raw materials. Probably there never was a war in which the belligerents were not cut off from one or more of their most needed raw materials, just as the United Nations have been cut off from their principal rubber supply in the present war and were cut off from a great portion of their chemical supply during the last war. With their supply lines dented and their economy thrown out of balance by excessive demands for man-killing equipment, a vigorous people must find ways to improvise, substitute and conserve their available material.

The Conservation Exhibit recently held in the Social Security Building in Washington, D. C., shows the kind of job that the people in Canada and the United States have done in this most important phase of war work. And any one who has seen that exhibit must surely be impressed with the importance of plastics and their role in this continent's conservation effort.

First item to strike the visitor's eye as he entered the room was a huge 9-ft.-long plastic buoy in the center of the Navy's interesting and all-inclusive exhibit. Last item he saw on the way out was probably one of the plastic parts in the aviation section.

Interesting feature of both first and last items is the figures which are posted on explanatory cards near them. The big red buoy of resin-impregnated fabric, integrally colored, weighs 300 lb. with and carries 158 lb. of concrete ballast. The steel buoy it was designed to replace weighs 650 lb. and takes 275 lb. of cast steel ballast. The plastic buoy thus not only saves hundreds of pounds of steel, but is easier to handle and requires no painting.

Figures on the last two items in the aviation display are equally interesting.

The data on the tail turret ejected ammunition hopper read like this:

	Laminated fabric-base phenolic sheet	*Alloy sheet*
Weight	1.26 lb.	1.60 lb.
Fabrication time	.19 hr.	1.10 hr.
Material cost	$1.43	$2.90

The card for the item next in line, a vacuum and manifold filter block, carries this information:

	Plastic	*Metal*
Weight	.22 lb.	1.23 lb.
Fabrication time	.25 hr.	.61 hr.
Material cost	$ .11	$ .60

Unfortunately, the United States display was gathered together so quickly that there was not enough time to provide this sort of information on any great number of items. But plastics manufacturers could ask for no better promotion or future sales arguments than these actual figures.

In most cases poundage of metal saved is only an incident. It is true that in the aviation applications metal saving is stressed, but saving weight in an airplane is something very different from mere conservation of metal. The important feature of this particular exhibit is its graphic method of showing that plastics not only performed in a pinch but frequently did a better job than the original material, and in most cases saved almost unbelievable sums in material cost and fabrication time. It doesn't take much imagination for any salesman to see how significant these cost items will appear to postwar customers.

Versatility of plastics is also a dominant feature of the exhibit. Thermosetting and thermoplastic products could be spotted in almost every section of the room. A stethoscope with plastic parts which demonstrates "the friendly touch of plastics" and nylon ligatures were only small items showing how plastics may be used by medical science; water lights and the buoy were only a hint of the many possible maritime safety applications that may be anticipated; instruments, cable insulation and food containers give some idea of what may be expected in ship equipment; waterproof clothing and shoe soles were only two of the ideas suggested for future development in the apparel line; tubing, pulleys, drill handles and electrical equipment seen at the exhibit put ideas for possible future applications into the minds of industrial-minded visitors. In fact, there was scarcely a peacetime branch of activity which was not represented in some way or another by a possible plastic application, even though the exhibit itself was intended to stress wartime conservation.

No mention of the exhibit could be complete without making special mention of the Navy's section. This is probably the first time that most people were made aware of the widespread utilization of plastics by the U.S. Navy. The buoy, medical instruments, signal pistols, innumerable nautical instruments including a binnacle stand of 35 lb. which replaced a 350-lb. brass instrument, food containers, binocular and telescope cases, life-saving equipment and actual ordnance items gave realistic evidence that the Navy has been in the plastics picture from the very beginning, despite what has seemed to be a desire on the part of its top officials to hold the line on "silent service" and keep most developments protected from puplicity.

Despite the excellence of the U. S. exhibit, it was overshadowed to some extent by the detail and research shown by that of the Canadians. However, it is only fair to point out that the Canadians have been working on their project for many months and have given considerable study to it. We are printing here their figures on several plastic applications.

Tank periscope prism holder—from aluminum to Bakelite
Savings: 79,200 lb.
792,000 hr.
$755,885
133 machine tools eliminated

Dial Sight and Binoculars—from aluminum to Bakelite
Graduated washer, small disk less than 2-in. in diameter and $^1/_2$ in. at thickest point
Eyepiece adapter (two), threaded hollow cylinders less than 2 in. long and less than 2 in. in diameter
Savings: 6531 lb. of aluminum
81,037 hr.
$55,147

Oil Bottle for rifle—from brass to plastic
Savings: 220,000 lb. of metal
$61,000

Air scoop, panels and containers in Anson Aircraft. Intricate design and large number of compound curves—from aluminum to plywood molded
Savings: In weight, 28 percent over metal. Plywood itself is molded which eliminates building up of the form from pre-cut veneer strips
182,000 lb. of material
Less hours of labor
Dollar savings considerable, but not computed

(*Please turn to next page*)

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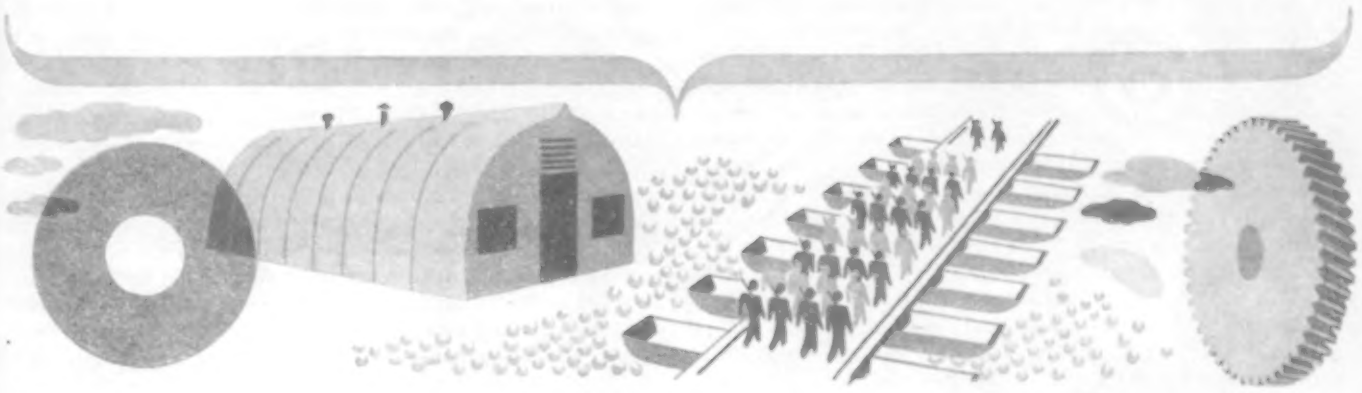

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LONDON LETTER

THE encouraging trend of war events is turning the minds of British plastics manufacturers more and more toward the postwar field with all its bright prospects. Thanks to the untiring goodwill work of the British Plastics Federation, it is safe to say that the idea of plastics as a major British industry has at last registered both on the minds of the British Government and the general public. There are encouraging signs from all directions as various postwar industrial plans become more fully outlined, that due allowance is being made for the inevitable and ever-widening influence of plastics. For instance, in several industrial development schemes that recently have been proposed—such as those for South Wales, the Highlands of Scotland and Northern Ireland—special emphasis has been laid on the possibilities of developing various types of plastics and other synthetic industries. It is being realized that the rapid expansion of the plastics industry and its extension into many new fields of building, engineering, household-ware, furniture and other trades, will provide an excellent means of absorbing much of the labor that will be released from munitions work as soon as the war ends. That is reason enough why the British Government now is showing a much more encouraging attitude to plastics in Britain and giving a growing amount of technical and research assistance "behind the scenes." It should be mentioned that in addition to the active Plastics Control, the Ministry of Supply's Advisory Service on Plastics and Rubber has earned much credit for its excellent work on various wartime plastics developments—many of which will be readily adaptable for important postwar uses. Bodies such as these—and the Ministry of Works Plastics Committee, the British Standards Institute's Plastics Committee, various committees of the British Plastics Federation and the Institute of Plastics—now are working together in an extremely harmonious manner that promises good for the future.

At the same time, British plastics manufacturers are not too happy about the "glamour" that has grown up around plastics and is reflected by widespread buying up of shares in plastics companies, etc. Consequently a number of our firms have been going to considerable trouble lately to impress on the public mind that even plastics have their limits. The case has been admirably put by a recent advertisement of British Industrial Plastics which stated: "That all-plastic house. We've no doubt it could be done—but what a price! Yet to listen to some people, we've only got to get the molds right and out the houses will come, like bullets from a Bren! . . . .Plastics in their many forms will certainly contribute to the better homes we hope to live in. Plastic moldings will bring color, lightness and cleanliness to a host of the smaller articles and fittings. Plastic surface finishes will set new standards for scratch resistance and easy cleaning. Plastic-bonded plywood and laminated construction will change traditional joinery methods. . . . But plastics are too valuable and versatile to waste on jobs which materials like bricks and mortar can do very well."

A more technical outline emphasizing the need for seeing things in proportion, was given by B. C. Westall, vice-chairman and managing director of Thomas De La Rue, Ltd., and chairman of De La Rue Plastics, Ltd., new subsidiary company, at the recent annual general meeting of De La Rue. Mr. Westall pointed out that De La Rue Plastics was the largest British company engaged in plastics molding and was altogether peculiarly well-equipped for large-scale plastics business, having interests in nearly every form of plastics including the manufacture of raw materials and production of laminates as well as very big research, tool equipments and staff. For this reason they had the greatest reason to hope for a bright future for plastics—yet, even so, he felt the public had got far too rosy an outlook about the future, an outlook largely based on misconceptions. What had to be remembered, he emphasized, was that plastics was a specialized craft. It would be a mistake to suppose that plastic molding could be economically applied to the production of practically any article. Plastics had to compete with metal and wood. In a large number of cases metal or wood were found to be more economic while in other cases, plastics were unsuitable. Again, the steel tools from which moldings were produced were very expensive to make. Consequently molding could only be an economic proposition when the number of articles required to be molded was sufficient to amortise the cost of these molds. Then again there was the danger of many manufacturers tending to install their own plastics molding departments as was the case before the war. Mr. Westall was convinced that this would be a mistake; the manufacture of plastics was an industry which in the future would see rapid changes in methods of manufacture, an industry where assiduous research must accompany production. Manufacturers would be well advised to concentrate on production of their own specialties leaving the making of such moldings as they require to those whose sole energies were concentrated on this specialized aspect.

Developing against this background of commendable caution, British plastics firms are making steady progress. Most firms are collaborating closely with the ambitious researches of the new British Coal Research Council, as a result of which it is hoped to develop British home-production of raw materials for plastics, rayon and other industries—the total of which now are expected to bring in £200,000,000 a year more to the national income. Research also is going on extensively in connection with fiber production—a field brought into prominence by the recent announcement that the first glider to be flown across the Atlantic was towed by a nylon tow-rope. It is being discovered that there is a big potential field for rayons of the acetate kind which can replace small ropes and cordage. On the other hand extended uses for jute and other fibers seem likely as a means of reinforcing many new plastics products—especially in the bonding of plastics materials.

Another interesting field for research is that concerned with paints and varnishes. In Britain since the outbreak of war, there has been a considerable extension of the use of synthetic resins in production of paints and varnishes. One of the most difficult problems was how to replace supplies of phenol previously imported from America. This was achieved with commendable success, largely through obtaining phenol by the isolation of xylenol from coal tar. British paint firms expect an increased postwar use of xylenol-formaldehyde resins, especially as they are now home-produced. Wartime conditions made it necessary to evolve another home-produced substitute—one for rosin. A fairly successful result has been achieved with a modified cresol resin—now being used in production of paints for various ammunition cases, etc. Coumarone and indene are two more materials which Britain has started to make out of her own resources instead of relying on imports as in the pre-war days. Synthetic resins made from them are being used for many forms of surface coatings and in electrical insulations. Alkyd resin oil compounds are being produced here, mainly for use in anti-gas paints and aircraft paintwork. Production of melamine-formaldehyde has been started. Good postwar prospects are held out for these materials and for thermoplastic resins of the vinyl type—provided the necessary (and intended) development of a home petroleum by-product industry is brought about. An interesting indication of this increased connection between paint production and plastics is the announcement that Lewis Berger, Ltd., about our biggest paint firm, has set up a subsidiary company, Berger Plastics Development, Ltd., in order to conduct research into uses of plastics in paint manufacture.

Now that British agriculture is at last being given the limelight, scientists are beginning to unearth promises of enormous developments of various raw materials and many of these are connected with plastics production. Speaking at a recent meeting of the Institute of Plastics, Dr. Harry Barron listed just a few of the valuable plastics materials (*Please turn to page 182*)

PLASTIC HANDLES

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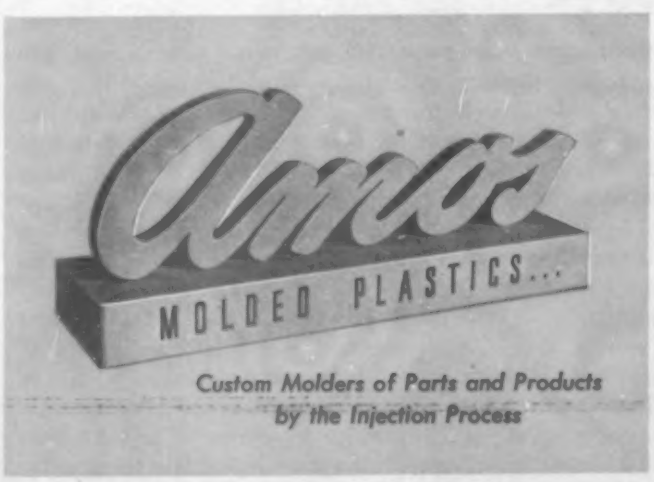
These are handles for hand-saws, hack-saws, aircraft control levers, motorcycle handlebars and vacuum cleaners. Below is a view of a typical handle showing the construction which gives it necessary strength—and saves on weight and material.



Custom Molders of Parts and Products by the Injection Process

Molded-laminated propellers

(Continued from page 113) In left foreground the tolerance on the 3-in. radius is −.001, +.002 in., but a variation of .020 in. is permitted on the section of the support which is shown in the right foreground. The micrometer indicator may read −0.0, +.050 in. on the right end of the part. It is by the use of such accurate checking equipment that the quality of these parts has been held to the high standard necessary for use in these propellers.

Spider phenolic ring

The second plastic part employed on these propeller assemblies is the spider phenolic ring, manufactured from the same type of laminated stock as is the barrel supporting block. This ring, which can be seen in Figs. 1 and 8, is designed to aid in the support of the barrel on the spider and to prevent the blade segments from digging into the spider. As in the case of the barrel support blocks, a laminated phenolic material is used because of its economy, light weight and ability to maintain accurate dimensions under load while immersed in warm oil. Several machining operations are necessary in the construction of this ring. Very accurate turning and milling produces a finished part built to a tolerance of ±.010 in. on outside radius, ±.002 in. on the thickness.

Another type of phenolic spider ring is shown in Fig. 9, mounted on the arms of a 4-armed spider which will be a component part of the 4-bladed propeller used on an Army Mustang fighter. These rings are lathe-turned and bored to equally close tolerances.

Blade chafing ring

The third plastic item, the blade chafing ring, is one of the more important parts from the engineering viewpoint. This particular piece is molded to its final shape, not machined. As its name implies, this ring is employed to take up the chafing that exists between the beveled thrust washer and the propeller blade butt. Figure 10, an actual assembly photograph taken in the East Hartford shops of the propeller manufacturer, shows the insertion of this ring between the propeller blade butt and washer. For the assembly of the propellers, three blades are mounted on a special truck. On this carrier the blades travel from point to point within the plant until they are completed. Then they meet with similar carriers bearing all the other component parts necessary for the assembly of a complete 3-bladed hydromatic propeller. A close-up of the butt end of one of these blades (Fig. 11) clearly indicates the position of the split phenolic ring. The position of the chafing ring is indicated in Fig. 1, a cutaway view of the completed propeller assembly.

Figure 12 shows the various stages in the manufacture of this part starting with the laminations of resin-treated fabric material which has been stamped out to the desired shape by a clicking die. As the next step in the formation of the preform, the ends of the segment are brought together and sealed in such a manner that the material takes the form of a truncated cone (No. 2, Fig. 12). This sealing operation can be seen more clearly in Fig. 13 where the two ends of the resin-treated fabric are brought together under the pressure of a metal roller. Heat is applied to the ends through a second hot roller located in the lower portion of this machine.

Referring back to Fig. 12, No. 3, several of the truncated cones are stacked together in order to make up the assembly for producing a finished ring of the desired thickness. The plastic rings in the bottom row in the same illustration (Nos. 4, 5, 6 and 7) show various stages in the finishing of the molded part. Part 4 is a cured ring just as it comes from the mold. A close-up of this molding operation is shown in Fig. 14. Here the operator is removing one ring from the mold with his left hand while with his right hand he loads the mold with a segmented preform. In the foreground indicated by the letters *S*, can be seen two cooling forms or shrink blocks. These blocks have the exact form of the finished part, and the weighted covers hold the rings in position until they are cooled, thereby eliminating the danger of distortion.

Part 5 in Fig. 12 is the first stage in the finishing operation. This ring has been trimmed on its top face by the use of a circular saw and a jig whose operation is shown in Fig. 15. Shearing and stamping of the blade chafing rings complete the finishing operations. The final shearing or splitting of the cones is necessary since it is only by virtue of this separation that the part can be assembled on the propeller.

These blade chafing rings are molded in several thicknesses so that the propeller blade torque may be exactly adjusted. The propeller manufacturer states that phenolic material is employed for these parts because it has been found to be best from the point of view of wear resistance and ability to maintain dimensions. The thickness of these molded chafing rings must be absolutely uniform if cracking of the blades in the barrel is to be prevented. They are molded to a thickness ±.002 in. inboard and ±.004 in. outboard and held to a total tolerance of .010 in. on the diameter. In Fig. 16 a group of inspectors are checking each one of these rings. A micrometer is used for gaging the thickness, and each part is checked at several different points. This 100 percent inspection is necessary in order to insure absolute accuracy. One poor ring could cause the loss of an important plane and the death or capture of its crew.

With over 76.8 percent of our warplanes employing these five molded-laminated phenolic propeller parts, their performance assumes important proportions. While the economy of this plastic has contributed to savings in airplane manufacture, the light weight of the laminated material and its excellent dimensional stability has helped to maintain the high performance record of our bomber and fighting planes.

Credits—Material: Formica. Parts molded and fabricated by Formica Insulation Co., for Hamilton Standard Propellers, Division of United Aircraft Corp.

Fire-fighting horn

(Continued from page 118) whereby water under 150 p.s.i. line pressure and at a temperature of 350° F., is circulated through the various mold platens. With this circulating water the force plugs recorded a temperature of 290° F. Through the use of a 3000-watt electric jacket booster, the cavity temperature was recorded at 320° F.

As was mentioned in connection with the assemblying of the brass inserts, the chase is mounted on a slide. After the force plugs are raised when the molding cycle is complete (Fig. 7), the entire chase can be pulled forward and centered over a novel knockout mechanism. A section of this unit is shown in the lower center portion of Fig. 8. Two knockout pins and four guide pins are mounted on a knockout plate (Fig. 5) which is connected to the piston of a hydraulic jack. With the chase pulled into the position

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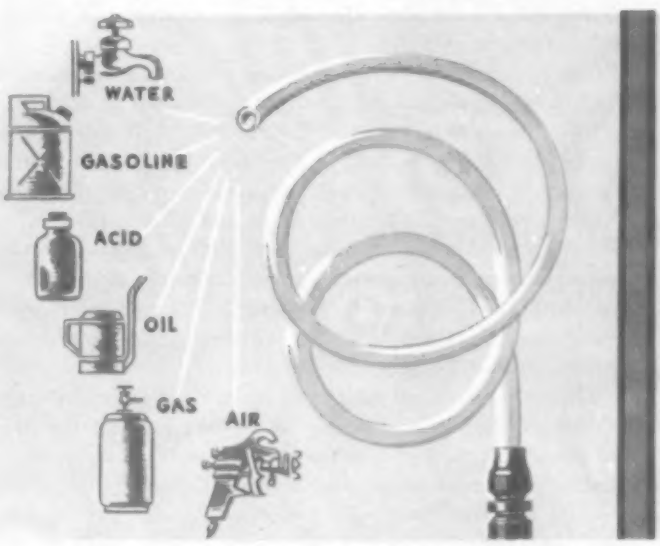

Let's make this point about Saran's resistance to chemicals perfectly clear. It is *not* resistant to *all chemicals*. But Saran's ability to function satisfactorily in contact with a surprisingly wide range of chemicals and solutions is greater than that of any plastic that has come within the knowledge of Dow technicians. It has greater resistance also than most of the metals.

These facts have been established by actual laboratory tests. Dow technicians have examined the behavior of Saran in contact with a host of chemical agents for long periods and its reactions are known. If you have a problem in chemical resistance, Dow invites your inquiry. Saran may be the answer.

Combined with unusual chemical resistance are Saran's other desirable properties, such as flexibility, moisture impenetrability, water-proofness and non-flammability. These properties make it a thoroughly practical plastic for the manufacturers of flexible tubing and molded atomizers (illustrated here) as well as such varied products as black pipe, colorful enduring fabrics, rope, window screen and thin moisture-proof film.

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shown in Fig. 8, the two holes into which the inserts have been assembled are lined up with the two pins in the knock-out assembly. Depression of a foot lever actuates this unit and the two fire-fighting horns are raised about an inch. The plastic parts then are withdrawn by hand (Fig. 9), and the threaded pins inserted in a vise where they are unscrewed from the molded-in inserts (Fig. 10).

Difficulties similar to those encountered in the molding of the horn were experienced with a phenolic holder for a paper sundae dish. In this piece which is molded vertically in a single-cavity mold it was found to be impossible to fill out the thick section to any appreciable extent. The material always seemed to set up in the thin neck before it had completely filled out the bottom section. Although this was a prewar job the company remembered the difficulty it had in molding the dish and decided to see what would happen if the oscillator was used for preheating the 120 grams of phenolic material which make up the preforms. With the mold temperature at 320° F., the dishes were molded so successfully through the use of the high-frequency oscillator that no difficulty is anticipated when material and labor again become available. The high-frequency preheating cut the curing time from 5 to $2^1/_2$ min. with no apparent dilatory effects. No light pieces were molded, and it would appear that the production of this piece would have no "molder's" rejects.

Once again the advantages of high-frequency heat have been demonstrated. Experience with the molding of the CO_2 horn shows that fragile pins and long thin force plugs can be successfully engineered in molds when an oscillator is employed. Experiments also indicate that material will flow so freely after being preheated by the high-frequency oscillator that it will fill out such tough molding jobs as the sundae dish holder. And it has been demonstrated again that with this type of preheating of the material curing time is reduced with the same mold temperature and similar or lower acetone extractables.

Credits—Material: Bakelite. Molded by Universal Plastics Corp., for C-O-Two Fire Equip. Co.

Remote reading compass

(*Continued from page 108*) consists of 5 molded parts. The 3 large pieces shown in Fig. 1 are made of a special woodflour material modified by an asbestos filler so as to resist the action of the compass liquid. The 2 rings are molded of standard Navy specification woodflour phenolic.

All 3 of the large transmitting parts are run in single-cavity, semi-automatic molds in order to achieve the dimensional accuracy required. The die for the base of the transmitting unit is shown in Fig. 3. On one of the large pieces the center boss is held to within ± .002 in. in diameter. The keyway in the same boss is allowed no more than a half degree maximum rotational tolerance with a ± .005 in. width. The demands of accuracy on each of these larger pieces holds the production rate to about 120 per day.

Approximately 1000 of the small webbed rings shown in Fig. 1 are produced in one day in each 4-cavity mold. On this part the mold is held to ± .001 to ± .005 in. on the inside of the diameter of the spokes and ± .002 in. on the inside of the outer projection. The other small ring must be within a total flat tolerance of .002. To achieve the absolutely clean finish on the inside which is required of this part, a diamond tool finishing operation is necessary. Made in a 7-cavity mold the ring is produced at a rate of about 1500 units a day.

Experience has proved the plastic case to have several advantages over the one made of aluminum. The present phenolic housing weighs 1.93 lb. compared to the metal case which weighed approximately 2.5 pounds. This is a tremendously important factor in an aircraft application. In addition, the plastic case can be made to proper dimensions thereby eliminating any machine operations—a saving of about 14 man-hours per unit. Furthermore the cost of tools and fixtures required for the machining of metallic cases approximates $4000 compared to a mold cost of about $2000.

Credits—Material: Bakelite. Molded by Boonton Molding Co. or Eclipse-Pioneer Div., Bendix Aviation Corp.

Lacquer-type fabric coatings

(*Continued from page 95*) 30 in. of water and freedom from cracking at 20° F.

Navy bedding bag.—This product employs a sateen fabric with a polyvinyl chloride coating and is used as a covering for mattresses or, during the day, for storage of miscellaneous garments. It is the object of this equipment to offer as much protection as possible against sparks and incendiary fragments which would readily ignite bedding and loose garments. As a result of the rough handling to which it is subjected over a wide range of temperatures, flex requirements of the film are an additional important property. The achievement of resistance to cracking together with adequate fire resistance involves a well-balanced formulation.

Other fire-resistant products include light-weight coated sheetings used as a covering for quilted pads in the lining of plane cabins, life preserver covers and fire resistant upholstery material discussed elsewhere in this article.

Life preserver cover.—This product is used as a fireproof and waterproof cover for the kapok pillows constituting a part of the life preserver jackets worn over outer clothing on board ship. In place of stitching, the edges of this bag-like cover are heat-sealed, making a water-tight seam. This is made possible by coating one side of the fabric with a suitable thermoplastic composition. The other surface of the double-coated fabric involves a heat-resistant coating which will not adhere to the die during the heat-sealing operation. Hydrostatic requirements not only apply to the initial coated fabric, but also to the material after the heat-sealed seam has been partially pulled apart, due to the fact that resistance to penetration of water, after the garment undergoes strain of service for several days, is vitally important.

Dye pouch material.—Another application of a coated product capable of being heat-sealed is the dye pouch carried as part of pilots' equipment. In service this package is ripped open and the orange-yellow dye thrown on the water where it spreads rapidly. The result is a contrasting color highly visible when viewed from a plane. Because the seal of the package holding the dye must be waterproof, the heat-sealing operation involves a good bond of uniform adhesion free from pinholes. For this product a double-coated sheeting is employed with a polyvinyl chloride resin coating. The material's fabrication into a dye pouch involves the same problems as in the case of the life preserver cover. Heat sealing also is involved as part of the fabrication of Army raincoat material and the parachute medical packet.

Upholstery material.—Requirements for military truck

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upholstery are quite similar to those of heavy-duty commercial material. Due to the restrictions on rubber, polyvinyl chloride resin coatings are finding increased use for this type of coated fabric product. Generally a cotton sateen or broken twill is used as the base fabric with a weight of coating approximately 10 oz. per sq. yd. For this application the strength of the fabric is an important requisite. The requirements of coating involve special consideration of anchorage as well as flex characteristics, particularly at low temperature. Where desired, this type of material also can be supplied as a fire-resistant product—of increasing importance for marine and aeronautical use.

Kit covers.—For various applications in which a rugged product is required as in the covering of tool kits or first-aid kits, double-texture fabric constructions have been employed. These involve various types of combining media including plasticized pyroxylin, polyvinyl butyral and polyvinyl chloride resins. Of course, combining strength is an important requisite, and the composition is so formulated as to result in a finished product of desired pliability. As a rule a light water-proofing coating is applied to the outside fabric as a matter of protection. Double-texture construction also is employed for such things as parkas and raincoats.

Aeronautical products.—The covering of certain parts of airplane surfaces (ailerons, tabs, wings, rudders, etc.) frequently consist of fabric treated with a cellulose derivative coating to give impermeability to air, tautness and durability. In applying these surface treatments to fabric following assembly, the conventional practice has been to brush on the first coats. This is followed by a spraying treatment until the desired film is realized. The operation is relatively slow due to intermittent periods of drying and to the time required for brushing and sanding. In addition, loss of solvent is appreciable.

Early attempts to use a predoped fabric resulted in a relatively stiff material which was extremely difficult to tailor into the desired shapes and fit over the airframe. A new development in this field has been that of a predoped fabric having a discontinuous film which possesses pliability and stretch little different from that of the uncoated fabric. This predoped fabric can be tailored and satisfactorily applied in the usual manner. Subsequently, when it is sprayed, tautness and anchorage in the desired degree are achieved. No brushing of the first coat is required with this material which can be sprayed directly with standard dopes. The greater smoothness realized with the predoped fabric also eliminates practically all sanding operations which are necessary with the use of untreated cloth.

In addition to its application over open structure framework, this predoped fabric is proving advantageous for covering solid plywood surfaces such as glider wings. In this latter case, instead of tailoring and sewing to a given pattern, the predoped fabric is adhered to a previously sprayed plywood surface in a manner similar to that by which wallpaper is applied. Once adhered to the plywood surface, it is sprayed with additional dope to realize the desired finish and color. This type of predoped fabric employs the standard cellulose derivative coatings corresponding to those regularly used on untreated cloth and conforming to standard Army and Navy specifications. Actual field tests have indicated satisfactory performances after nine months' service.

Conclusion

In conclusion it may be mentioned that in practical manufacture of these coated fabric products, rigid control is necessary not only in the case of the various resins and plasticizers employed but also with the finished coated material. This fact has involved new types of testing equipment—particularly as regards low temperature in the range of 0° F. to −60° F. Exposure and service tests of new materials afford additional means of realizing improvement in the interest of the better adaptation of these products to the particular requirements of military use.

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Plastics in aviation

(*Continued from page 103*) and probably designed along conventional lines.

Plans are now underway for establishing flying and aeromechanics as a "must" in high school and college educational systems. We must, for our own defense, set up a system which will guarantee a steady supply of trained pilots. To fit into this picture, planes must be in the low-priced class. This is well within the realm of possibility for standardization and mass production can do for aircraft what they did for the automotive industry.

It has often been stated that the miracles of today are the commonplaces of tomorrow and this is especially true in the aircraft field. With the establishment of proper ground facilities, the businessmen of tomorrow will fly to their offices and appointments. Doctors will be able to cover vast areas of ranch and farm country, and ranchers themselves will be able to cover in a few hours distances that formerly required days of travel.

The helicopter, when fully developed, will fill the void that now exists between the airplane and the automobile. A flying machine that can fly forward, backward or sideways, hover stationary over a given point, or take off and land vertically provides the answer to flying from farm to town on the part of the farmer, or from home to business on the part of the commuter.

Helicopters for use in fire and insect control, by the Coast Guard in rescue operations, and by the commercial fisherman and those employed in similar industries, do not have to cater to public demand to be salable. A great many established helicopter routes have already been applied for and postal services and transportation industries plan to use the heli-

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copter for feeder systems into main trunk lines. These feeder systems alone can bring postal and cargo service within the reach of every locality in the country.

Distances between home and place of business will become less important, many commodities will become available within a matter of hours to all parts of the country or as, a matter of fact, to all parts of the world. Your own back yard will be your landing field and the distance you travel will depend upon how much gasoline you can afford to buy.

Our planes will span the oceans and will carry commerce to all parts of the world. Natural boundaries will cease to restrict our travels, and our skies will be filled with the traffic of peacetime. Imagine traveling from Washington to London in ten hours for under $100. Fantastic, you say? Not at all. One of our leading airlines has actually taken steps to make this a possibility.

It must be pointed out that the extensive development of air travel and commerce will not work severe hardship on the ocean liner and cargo ship. It is to be expected that only goods too perishable to be shipped by ocean freight or merchandise needed immediately will be shipped by air. The speed of air travel should not materially reduce normal ocean travel and commerce but instead will broaden definitely our over-all world commerce.

Although some of our military aircraft can be converted to handle passenger and cargo requirements, we must also have large numbers of cargo planes designed around shippers' needs and with costs per ton, per mile and per hour in mind.

Where do plastics fit into this picture? The answer is quite simple. In postwar cargo aircraft we will utilize the light weight, speed of production, high strength and electrical characteristics of plastics in many functional parts. For civilian aircraft we must add low cost, color possibilities and design for eye appeal. The two latter points will be just as important to the civilian aircraft industry as they were in the automotive field. In the immediate future metal assemblies will be used for most primary structural parts and plastics for many secondary applications and functional parts. Some combinations of plywood, thermosetting copolymer resins and laminates will be used, and it is expected that some of the new plastics in combination with high strength papers, fabrics and glass cloth may go far in utilizing the best characteristics of plastics for airplane parts.

Here are a few predictions regarding the civilian aircraft of the future. It will probably be of the helicopter type or a variation of this general design. The fuselage will be molded in two halves, either of plastic-bonded plywood and fabric or of thermosetting copolymer resins, reinforced with a suitable fabric or fiber. Fairings will be made of formed plastic and all low-pressure piping will be of extruded plastic tubing. Control systems will utilize plastics in fairleads and pulleys and the control panel will be one single molding.

The use of transparent resins will provide for a completely transparent compartment having at least 80 percent vision. Wings and tail assemblies, if of a conventional type, will be of plywood, phenolic or thermosetting copolymer laminates. Bulkheads and seats will be of single pressing laminates and the fittings for many of their parts will combine both metal and plastics.

In electrical systems, no radical change over present uses is expected. Battery cases will be of polystyrene, insulation will be provided by the vinyl groups and most of the electrical applications will be of melamine resins or phenolic-based material. Instrument dials and radio parts will be plastic, probably polystyrene or phenolic resins. Flooring and reinforcing strips will be high strength paper and phenolic combinations or fabric and resinous-based materials.

The interior of the plane will be much like the automobile of today with the accent on comfort and color. Here we will find molded acetate window frames contrasting in color with the cellulose acetate rayon fabric upholstery. The seats may be covered with vinyl coated fabrics or woven of extruded strips which will wear considerably better than high grade leather. The controls will be of plastics, probably cellulose acetate, polystyrene or ethyl cellulose and knobs and escutcheons will be molded as well. One could go on indefinitely for the possibilities are governed only by the imagination and ingenuity of man.

When will all this come about? The answer to that is simple, for it has already come about. It is not a far cry from the bomber of today to the family car of the air of the postwar period. Test data on many of these plastic applications are complete and the parts are in use at the present time. Others have been tested and are on the drawing boards of the aircraft industry. It would not be correct to say that we will have an all-plastic airplane in the future but the plastics industry certainly can and must play an important part in postwar aircraft planning.

Although much has been accomplished in the use of plastics in secondary structural parts, there is still a long way to go in using them for primary structures. We need stronger and lighter resins, resins with greater toughness and stability. We must realize that the war has been responsible for far-reaching technical advances in both plastics and aircraft which would normally have taken many years of peacetime endeavor to equal. We must be prepared to take advantage of the many developments in the plastics field and by contact with the aircraft designers assure ourselves of their incorporation in postwar design. We must also be prepared to transfer these wartime applications to peacetime aircraft.

Production of resins, 1942

(*Continued from page 132*) and naphthalene. Shortage of raw materials and allocation of them principally to military and essential civilian uses account for the decrease in output of some of the products.

The production of miscellaneous coal-tar products increased from 156 million pounds in 1941 to 228 million in 1942, principally because of an increase in the output of plasticizers and photographic chemicals. The output of non-coal-tar miscellaneous chemicals rose from 4.9 billion pounds in 1941 to the all-time peak of 7 billion in 1942. The large increase was due, in a considerable measure, to their use in the expanding manufacture of plasticizers, synthetic rubber, synthetic fibers, resins, and in solvents. Approximately 59 million pounds of synthetic rubber were produced in 1942; the sales value per pound was 60 cents.

Strict classification of these products according to coal-tar or non-coal-tar origin is no longer possible because a considerable number of identical products are now obtained from both sources. Compounds of coal-tar origin are generally cyclic in nature. In conformity with general industrial practices and with practices prevalent in the chemical literature, cyclic (benzenoid) compounds are classified in this report as coal-tar products, and non-cyclic (aliphatic) compounds are classified as non-coal-tar products, regardless of origin. A few special carbocyclic compounds are listed among the non-coal-tar products.

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Advances in plastics, 1943

(*Continued from page 126*) Studies of the behavior of urea-formaldehyde molding compounds under various curing and conditioning treatments were reported.[180, 181] Chemical[182] and physical[183] properties of laminates were discussed. A review of the strength and optical qualities of cast methyl methacrylate sheet plastic was published.[184] Other topics considered by various authors included mechanical strength at low temperatures,[185] ignition points,[186] electrical properties,[187] and toughness.[188]

Three noteworthy guides to identification of plastics appeared in the literature during 1943. Two of these pertained to resins used in commercial molding compounds[189, 190] and the third was concerned with plywood glues.[191]

Committee D-20 on Plastics of the American Society for Testing Materials completed action on a record number of testing methods and specifications for plastics. Six new tentative methods of test were adopted and six others were advanced to the status of standard methods. Sixteen specifications for plastic materials were prepared by Committee D-20 and approved by the Society during the year. These covered phenolic, urea, melamine, styrene, vinyl chloride-acetate, vinylidene chloride, cellulose acetate and cellulose acetate butyrate molding compounds; cellulose nitrate, cast methacrylate, vinyl chloride-acetate, and laminated thermosetting sheets, rods and tubes; and nonrigid vinyl chloride, vinyl chloride-acetate, vinyl butyral and ethyl cellulose plastics. Development of other testing methods and specifications was undertaken by this committee during the year.

Books

This review of advances in plastics during 1943 would not be complete without mention of several excellent contributions in book form to the technical and trade literature. The Plastic Materials Manufacturers' Association issued a compilation of technical data on plastic materials.[192] The Society of the Plastics Industry prepared bulletins dealing with assembly gluing[193] and extruded plastics.[194] The American Society for Testing Materials brought together in one booklet all of the specifications and testing methods developed by the Society for users and manufacturers of plastics.[195] Two further additions were made to the American literature on the chemistry of high polymers.[196, 197] The growing alliance between agriculture and industry as typified by the use of raw materials from the farm and forest in the manufacture of plastics was reviewed in a nontechnical vein.[198] A comprehensive reference work concerned with the physical and chemical properties of plastics and their production, fabrication and application was published.[199] At the close of the year another edition of the well-known Plastics Catalog appeared with its scope expanded by new articles and charts covering all phases of the plastics industry.[200]

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Please turn to page 180)

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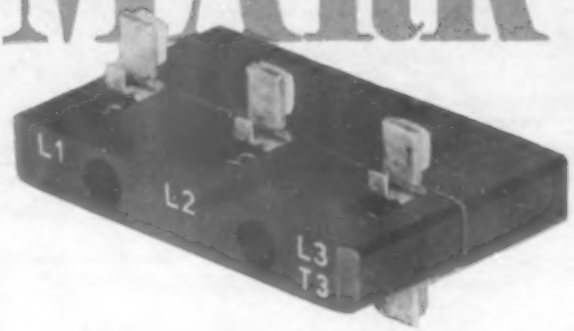

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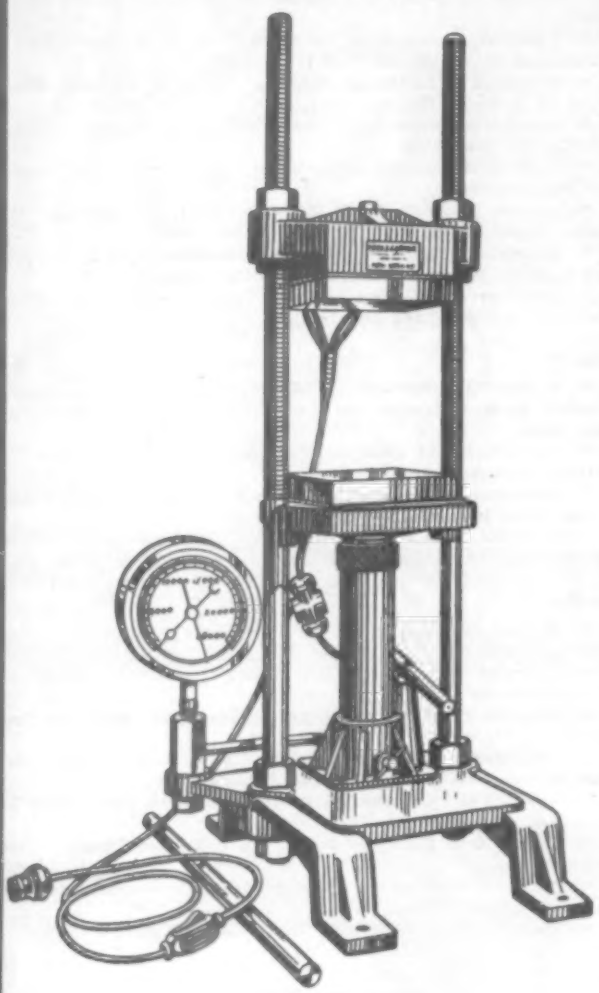

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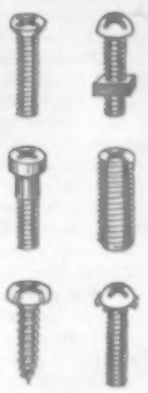

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London letter

(*Continued from page 168*) Britian now was obtaining from her own land—cellulose, soya bean, milk, waste stalks, cobs and hulls for producing furfural, lignin and alcohol. Experiments are also going on into the possibilities of deriving some type of plastics materials or compounds from ordinary seaweed—a material out of which a British firm is already making a sodium alginate basis for a new artificial fabric. The production of new drug Penicillin also is the subject of extensive British research, and the Ministry of Supply has a Penicillin Research Committee working on this under the discoverer of the drug, Professor Fleming.

Among new British products noted is Komrok, a mixture of siliceous compound and an organic binder of synthetic resin with or without drying oil. It forms a doughy mass capable of being laid in the form of flooring. The makers are Ernest Simmons and Co., 168 Regent Street, London. A new process for application of synthetic resinoids to the manufacture of anti-corrosive and anti-fouling coatings of various types has been evolved by Plastic Sprays, Ltd., a London company—the process now being marketed under the name Plastoglaze. Although no stoking ovens are used, the resinoid (basis of phenol formaldehyde) is

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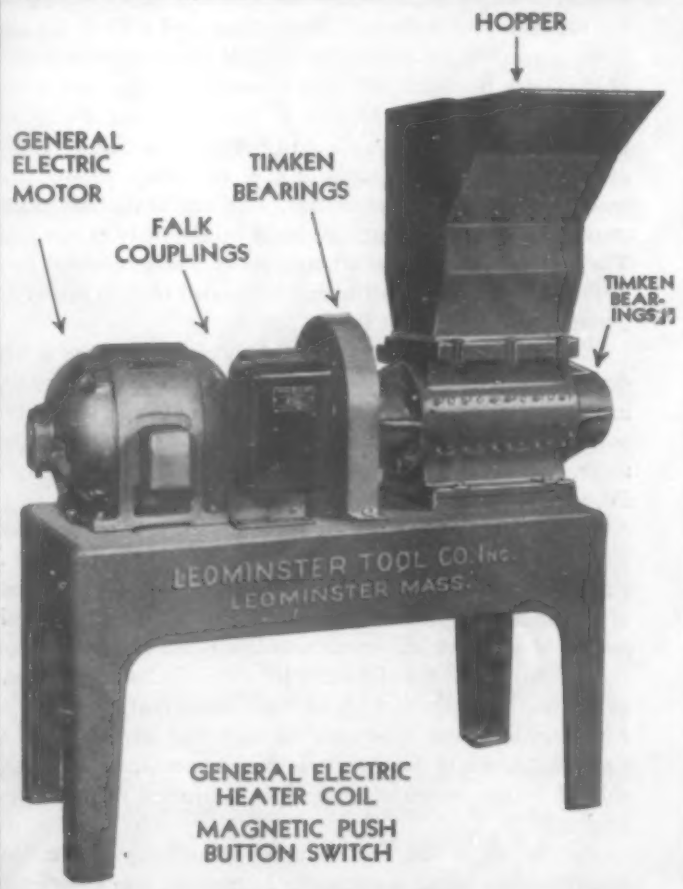

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These plastic granulating machines have been developed to give the plastics industry a sturdy, economical piece of equipment. Each comes equipped with one screen, ¼" or ⅛" mesh, which can be interchanged in 2 minutes. Hopper swings back for easy cleaning. Granulated material is delivered through end chute.

Best grade of alloy steel is used for blades and cutter. Spindle is made of high tensile strength alloy steel, hardened and ground. Timken roller bearings assure long life, trouble-free operation.

2 MODELS

Model #1		Model #2
3 H. P.	Motor	5 H. P.
100-lbs. per hour		200 to 400
46" x 18"		Floor space - 68" x 24"
680 lbs.		Weight 870

MANUFACTURER OF

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cured in a shorter time than that normally required for stoving. This is partly because of the use of a special coating composition, a combination of phenol formaldehyde resinoid, plasticizer, accelerator and thinners. The coating is sprayed on the surface and within a few minutes a special hot treatment is applied which enables the coating to be cured in 10 min. An advantage of the process is that it can be operated by unskilled labor. Another new development to be noted is the setting up of a new company, Plastic Pulpware, Ltd., London, which aims "to carry on the business of manufacturers of and dealers in paper, cardboard, strawboard, papier maché, molded processes incorporating the use of waste paper and sawdust fibre." Among processes still in the experimental stage are (1) production of a plastic compound of paper and resins to be used in aircraft production, and (2) development for postwar trade of plastic trays to replace wooden trays—the trays made from laminated materials using urea glues as adhesives. Another development I hear of is that of increased use of infrared rays in the drying and heating of plastics, especially in the paint industry. Infrared rays now are used in the building up of structures from resin-bonded plywood where the production of heat by electricity is not suitable because of the type of clamp holding the laminated surface.

There is news here of rapid expansion of plastics production in Canada including such interesting specialties as aeroplanes built on resin bonded plywood structures and a plastic hand grenade—but such details are probably well known in neighboring America. It may be of interest to mention that the British Government in India has stimulated research into potentialities of various Indian raw materials—one result being the conversion of jute waste into a molding powder by heating it under pressure and using certain acids and chemicals. The thermosetting powder obtained can be molded at 150°C. and a pressure of 3000 p.s.i. within 3 mins.—plus the use of small amount of plasticizer. The powder ranges in color from chocolate to brown and is very light. Molded products have a glossy appearance and can be drilled. Material is called Jutelite, and the research came from Dr. B. C. Guha, Calcutta University. (*Denys Val Baker.*)

Conservation exhibit

(*Continued from page 166*)

Main conduit panel, Anson Aircraft (1 per aircraft)—from aluminum to hand formed plywood, cabinet work

Savings: 6138 lb.
46,872 hr.
$41,961

Sea marker container—from aluminum, punch press, hand forming, to plywood

Savings: 3906 lb.
8370 hr.
$21,940

Light series bomb door—from aluminum, punch press, hand forming to plywood

Savings: 33,480 lb.
78,120 hr.
$129,456

Detachable gun panel—Aluminum, punch press, hand forming to plywood

Savings: 12,276 lb.
40,176 hr.
$43,858

Tank cover, Canadian Anson Aircraft—from aluminum, punch press, hand forming, to plywood, cabinet work

Savings: 52,452 lb.
122,700 hr.
$227,039

The conservation exhibit was not intended as a horn-blower for plastics, but it certainly did a job for the advancement of information on the utility of plastic materials. Another advantage is that it was seen by thousands of industrialists who could not help becoming aware of the plastic influence on war materials; and who were almost certain to carry back with them the knowledge that plastics would be prime materials in postwar industry.

"Sighted sub, sank same"

(*Continued from page 86*) mounted, and an arrangement whereby a hammer inflicts a blow upon steel pads welded to the plate at the point of impact of the hammer. Each sample alidade was secured, one at a time, to the plate exactly as it would be installed aboard ship. The instruments were placed in such a position that the side and back blows came about the center of mass of the steel clamping bracket. Alidades with parts molded of various high-impact materials were tested with the result that a material of CFI 10 (medium shock) type (Bureau of Ships, Ad INT Spec. 17P4) was determined to be satisfactory for the body, and little or no difference was noted by the use of either CFI-10 or CFI-5 (shock resisting) types for the base since this part is reinforced by the steel clamp bracket. Considerable cracking of the body or housing was noted by the use of CFI-5 type, but the introduction of the fabric filler in the CFI-10 type for parts of instruments that were tested later minimized the cracking to a negligible degree. Considerable breakage of gear teeth was discovered by the use of the two types of materials mentioned above for the dial mount and gear, and base gear. Later samples with the dial mount and gear, and the base gear, molded of CFI-30 (high shock resisting) type completely solved the breakage problem of the molded gears. Instruments consisting of CFI-10 for the body and dial cover, CFI-5 for the base and luminous plate holder, and CFI-30 for the gears, remained completely serviceable after the completion of the shock test with only minor cracking at the base of the housing caused by a whipping of the steel shaft about the reduction where it enters the ball bearing located at the top of the base. The whipping of the steel shaft allowed the body to come in sharp contact with the stationary base, causing small fractures at that point on the body or housing. The whipping of the shaft under shock was minimized to a negligible degree by substituting a rounded fillet in lieu of an undercut in the shaft at the reduction.

It is interesting to note that the shock tests of the newly designed instrument, molded primarily in plastics, proved the instrument to be approximately six times as resistant to the particular shock test as the old Mark IV alidade. One 2000 ft.-lb. blow, in a line perpendicular to the shaft of the Mark IV, was sufficient to render it completely useless.

Monthly production of the plastic alidade is at present four times that of the Mark IV, and there is the possibility of a still further increase. The new design has reduced the cost of the alidade by almost 50 percent. In addition, the elimination of an electrical circuit and labor cost attendant upon its installation, and a reduction in other incidental work has saved the Navy quite a bit in the overall cost. Danger of corrosion has been overcome through the use of plastics. Corrosion is one of the most troublesome problems to be considered in the design of equipment subjected to salt water atmosphere.

This is one of the first instances of military conversions from metal to plastics where the instrument was completely redesigned to take full advantage of the qualities of plastics.

Exact Weight Scales

Plastics Ingredient Compounding — a Precision Weighing Operation . . .

Plastics ingredient compounding is only as good as the scale used for the operation. Careful attention to formulae and close adherence to the weighing of each ingredient assures a great part of the success attained in the finished mold. Not only are EXACT WEIGHT Scales absolutely accurate but they have the added feature of speed of operation. This is especially true of end-tower models, so popular with the industry as a whole. Model #273 (illustrated) is rugged, works anywhere on level or out-of-level benches. Dials are easy to read, oil dashpots give instant readings without delay. You have ample capacity (12 lbs.) for any ingredient work. Other uses include color blending and check-weighing.

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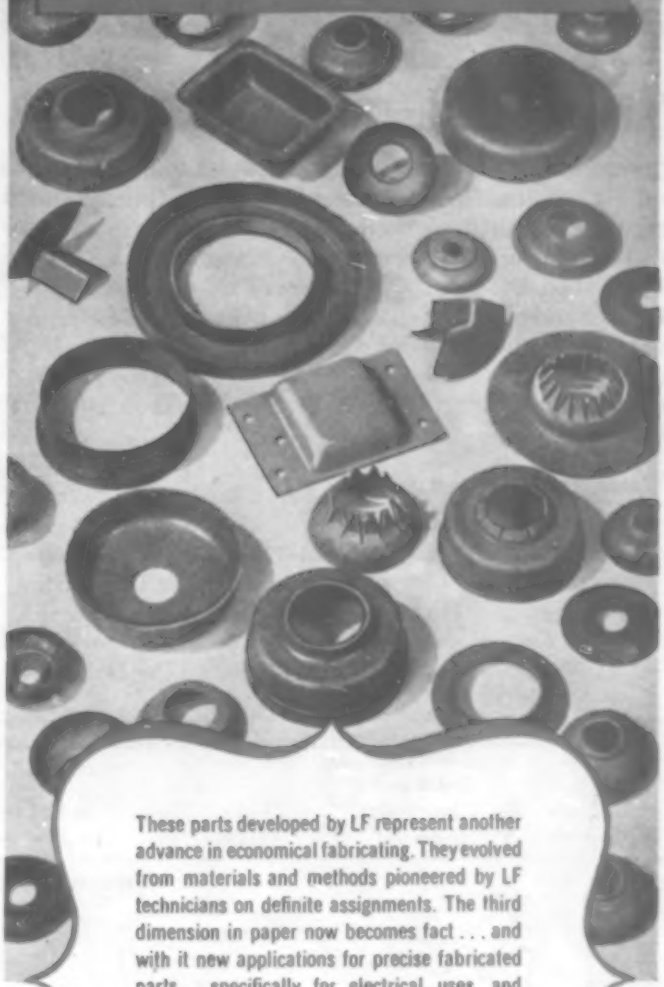

These parts developed by LF represent another advance in economical fabricating. They evolved from materials and methods pioneered by LF technicians on definite assignments. The third dimension in paper now becomes fact . . . and with it new applications for precise fabricated parts . . . specifically for electrical uses, and for many others.

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This experience indicates that molded plastics have a very definite place in applications not heretofore anticipated. The increased use of plastics, if controlled by 1) adequate strength tests made during the design period, and 2) consideration of the stability factor of the material to permit its use for the particular equipment, will go far to accelerate production and decrease costs. This example should encourage the use of plastics in other new fields, not only during the period of the present emergency but in the peace that is to come.

Credits—Material: Bakelite, Bakelite polystyrene. Molded by Northern Industrial Chemical Co. for Daystrom Corp.

Thermo-elastic forming

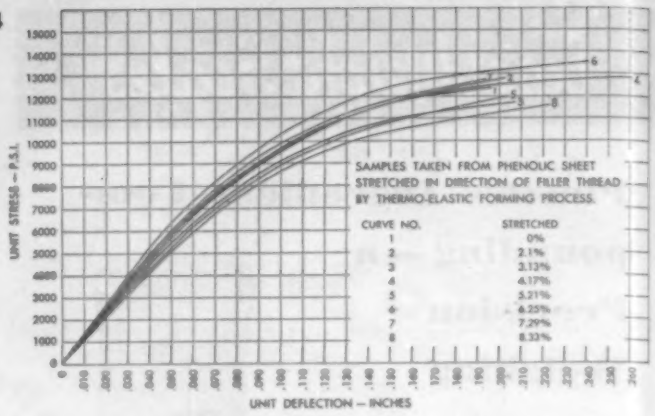
(*Continued from page 131*) 1.75 in., which is the minimum set of the machine. A greater distance between the supports permitted the specimen to be subjected to impact without fracturing. Therefore, deviations from A.S.T.M. Designation D256–41T were necessary for testing the 1/16-in.-thick sheet material. The impact strength of the specimen was sufficiently high to give comparative values. The results of the impact tests shown in Fig. 17 are somewhat comparable to the shear test. Here again the bias curve is superior to the others.

Water absorption test

The water absorption test was conducted in accordance with A.S.T.M. Designation D570–42. All specimens were 1/16 in. thick, 1/2 in. wide and 3 in. long. Table III includes the averaged data for 3 specimens in each group immersed in water for periods of 24 and 48 hours.

(*Please turn to next page*)

14



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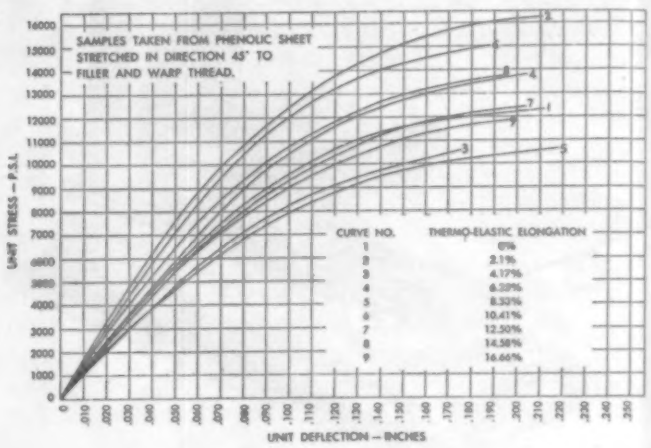

14, 15—*Flexural test of laminate NA2-4141*

TABLE II.—EFFECT OF THERMO-ELASTIC FORMING ON FLEXURAL PROPERTIES OF GRADE C, TYPE II, LAMINATED PLASTIC

Specimen group No.	*Stretch in 6-in. gage length, percent*	*Thickness after stretching, in.*	*Actual deflection, in.*	*Ultimate load, lb.*	*Modulus of elasticity, p.s.i.*	*Ultimate bending stress, p.s.i.*
			BENT ACROSS THE WARP THREAD			
1	0	.063	.612	12.004	705,000	13,768
2	2.11	.062	.675	12.081	735,000	15,536
3	3.13	.062	.600	10.712	665,000	12,522
4	4.17	.065	.671	14.496	695,000	15,278
5	5.21	.062	.662	12.087	720,000	14,891
6	6.25	.064	.561	12.124	805,000	14,634
7	7.29	.068	.950	11.388	360,000	10,978
8	8.33	.066	.975	9.888	310,000	10,014
			BENT ACROSS THE FILLER THREAD			
1	0	.061	.588	10.516	685,000	12,461
2	2.11	.063	.593	11.316	680,000	12,798
3	3.13	.065	.663	11.085	540,000	11,750
4	4.17	.062	.780	11.038	525,000	12,881
5	5.21	.067	.748	12.047	480,000	12,027
6	6.25	.073	.719	16.270	520,000	13,569
7	7.29	.062	.631	11.100	655,000	12,964
8	8.33	.066	.658	11.188	525,000	11,534
			BENT AT 45° TO FILLER AND WARP THREADS			
1	0	.064	.641	11.092	595,000	12,312
2	2.11	.065	.634	13.897	780,000	16,232
3	4.17	.062	.520	9.135	650,000	10,596
4	6.25	.062	.608	10.706	730,000	13,768
5	8.33	.061	.655	8.906	525,000	10,637
6	10.41	.064	.559	12.932	835,000	15,104
7	12.50	.063	.598	10.916	650,000	12,368
8	14.58	.069	.578	14.328	685,000	13,812
9	16.67	.065	.590	9.914	610,000	11,857

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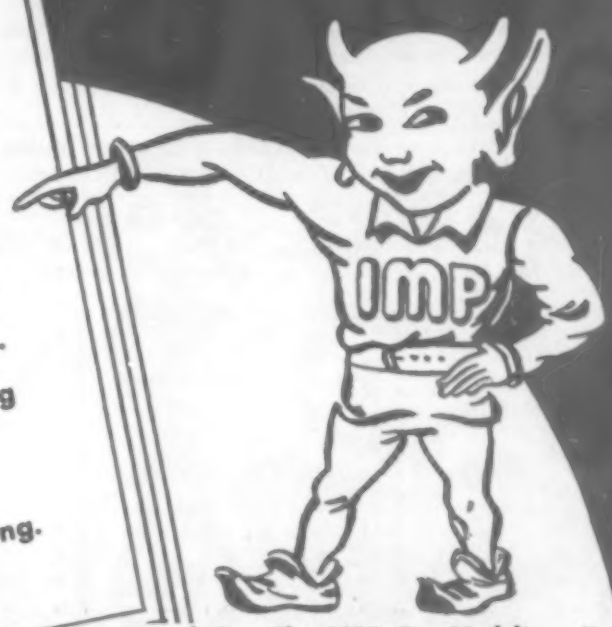

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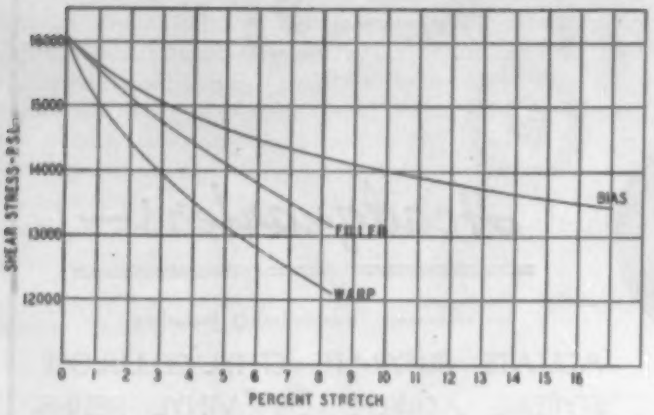

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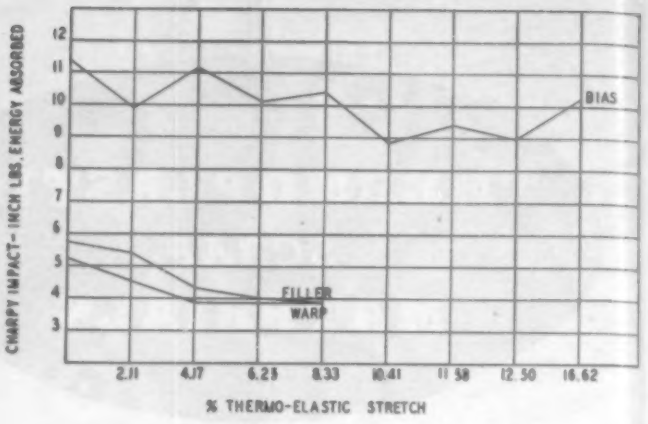


17

16—Shear test of thermo-elastic processed laminate NA2-4141. 17—Impact test of the same laminate

Summary

The results of the tests included herein submit limited data for present use and, what is more important, a basis for more substantial design criteria pertaining to the forming of thermosetting materials. The information is sufficiently indicative to warrant a wider employment of formed laminates in many applications previously believed unsuited because of lack of data. Contingent upon the magnitude and nature of the applied load, it is seen that formed parts may be dealt with in such a manner that they ultimately possess better physical properties than were present in the flat, unformed sheet material. Judicious selection of thread direction is necessary, whether the part has a simple right-angle bend or compound curvature.

The data obtained from these tests are peculiar to one type of laminated product only. Others may produce better or inferior properties, depending upon the type of resin and fabric processed. Some modification of the resin may eventually take care of those characteristics which at present limit the scope of the material to non-structural applications. As for formability, the limiting factor is the type of filler material incorporated in the laminate. A fabric that forms readily in any direction combined with ample elongation of the weave will go far to produce more desirable forming stock.

TABLE III.—EFFECT OF THERMO-ELASTIC FORMING ON WATER ABSORPTION OF GRADE C, TYPE II, LAMINATED PLASTIC

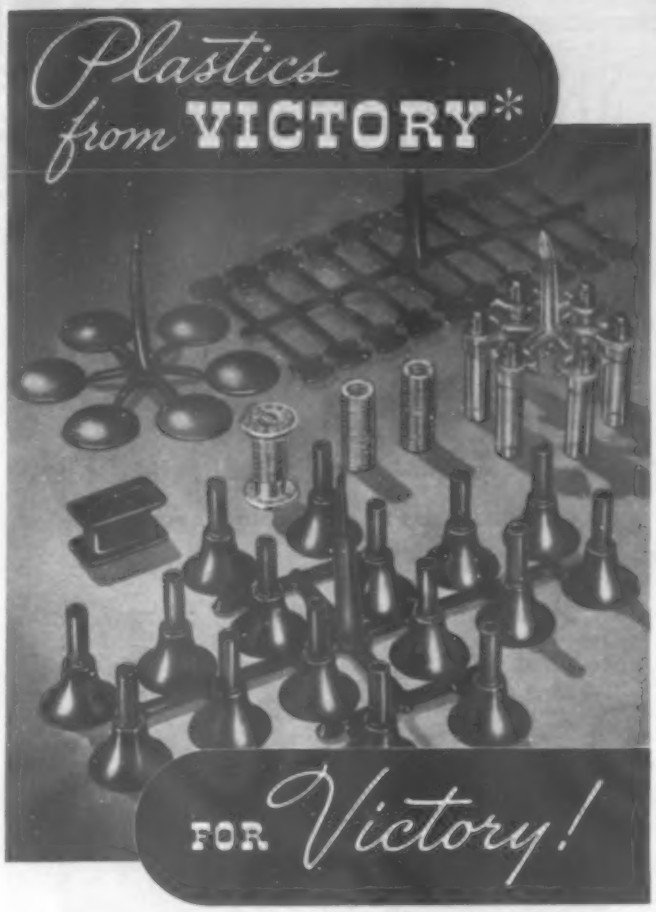
Specimen group No.	*Stretch in 6-in. gage length, percent*	*Water absorption 24 hr., percent*	*48 hr., percent*
STRETCH IN DIRECTION OF WARP THREAD			
1	0	1.8	2.6
2	2.11	1.6	2.7
3	4.17	3.6	4.3
4	6.25	4.4	5.3
5	8.33	5.9	6.1
STRETCH IN DIRECTION OF FILLER THREAD			
1	0	2.1	3.1
2	2.11	1.8	2.8
3	4.17	2.7	3.8
4	6.25	5.6	6.3
5	8.33	5.1	5.9
STRETCH IN DIRECTION 45° TO FILLER AND WARP THREADS			
1	0	2.2	3.1
2	2.11	1.5	2.3
3	4.17	1.7	2.7
4	6.25	2.0	3.1
5	8.33	3.0	4.2
6	10.41	3.8	4.8
7	12.50	4.5	5.1
8	14.58	6.4	7.1
9	16.67	7.0	7.4

Speeches of the-month

(*Continued from page 164*) Cyanimid Co., George K. Scribner, president of Boonton Molding Co.; and Morris Sanders, architect and industrial designer. After a few prefatory remarks upon the general topic, the moderator introduced Mr. MacHale who touched on some of the outstanding industrial advantages of plastic materials. This speaker also brought out the fact that in spite of the over optimistic picture painted by certain popular writers, engineering designers are well aware of the limitations of these new materials and recognize that there are certain jobs which plastics cannot perform. Mr. Scribner continued the discussion with a brief survey of the rapid growth of plastics applications as a result of the war and gave a hint of what we might look for in the future. Mr. Sanders considered plastics from the point of view of functional utility, comfort and esthetic value.

★ ON NOVEMBER 8 LAWRENCE OTTINGER, PRESIdent of the United States Plywood Corp., lectured before the New York Institute of Finance on "Plastic Plywood." Illustrating his points with an exhibit of war and peace-time products, Mr. Ottinger described the more dramatic contributions made by plywood to our military needs and forecast some of the developments to be expected as a result of these applications. One of the highlights of the talk was the story of the essential part played by radar masts of plywood tubing in the wholesale destruction of Japanese ships in the battle of the Bismarck Sea.

★ AT A MEETING OF THE PLASTICS INSTITUTE Alumni Association held Dec. 16 in the Pennsylvania Hotel, New York, N. Y., an early item on the program was a brief report by Arthur Berger, a recent graduate of the Institute, on the inspection of electrical condensers in a defense plant. Apart from the discussion of inspection problems, Mr. Berger's talk, which was based on employment as an inspector during the past summer, offered members a suggestive example of the unusual opportunities now open to students for gaining practical knowledge of plastics production. Gregory W. Blessing, of Gregory Blessing Associates, New York City, gave the featured talk of the evening, on "Electronics as Applied to Plastics." Mr. Blessing, after listing the important advantages gained by the plastics industry through the use of the electronic heating process, cautioned against its use in cases where it would not do a better job than other methods of heating or reduce the time cycle or production costs.



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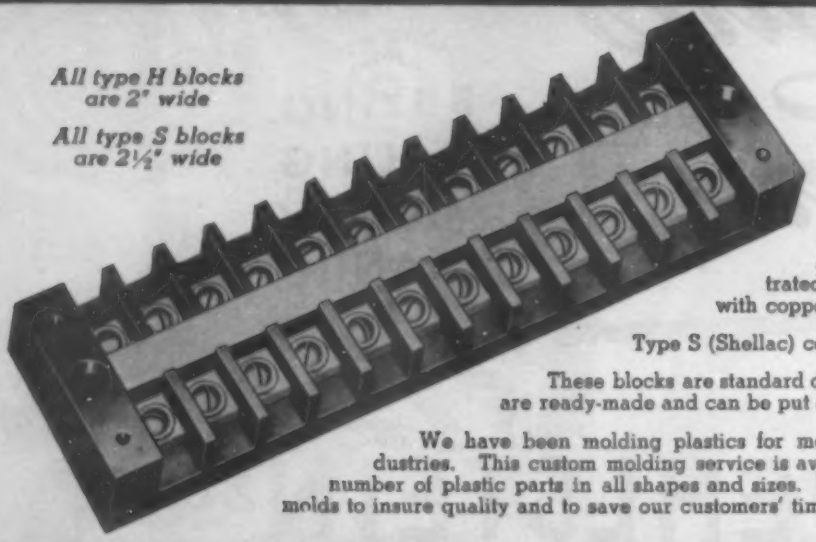

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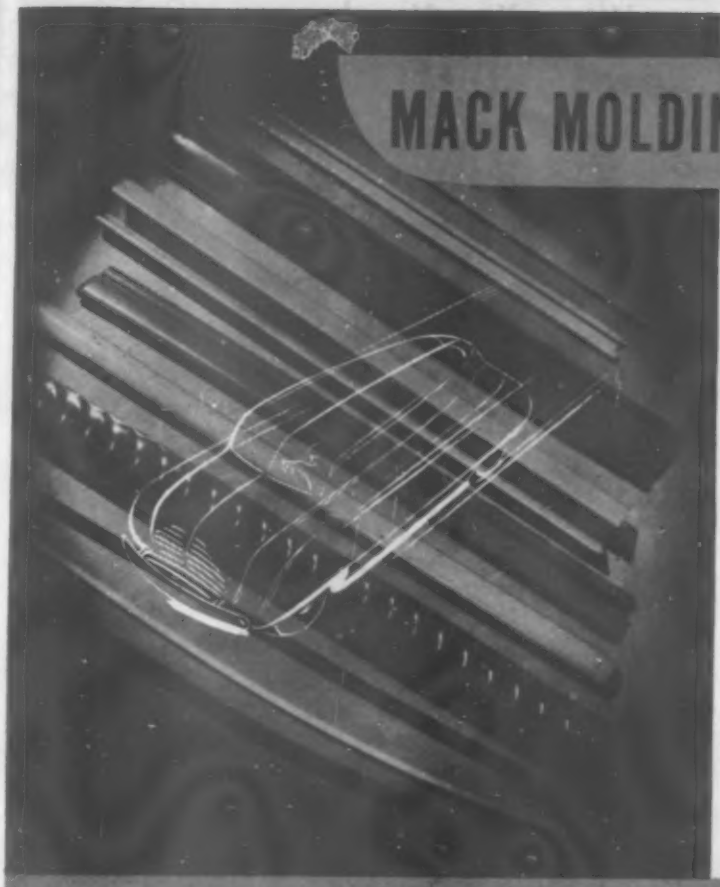

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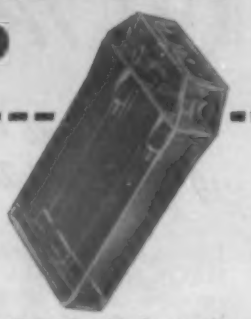

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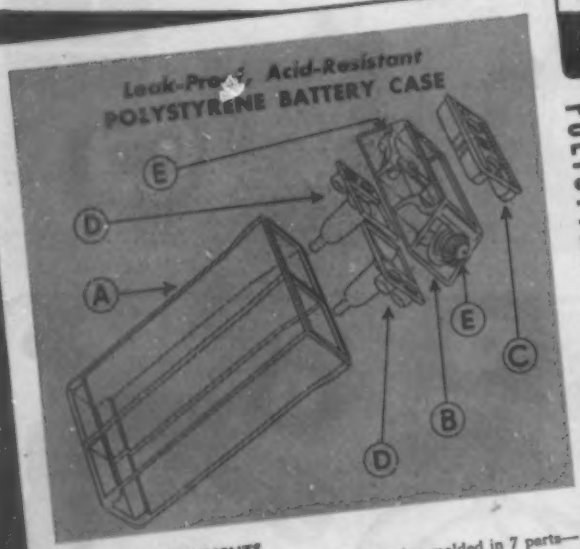

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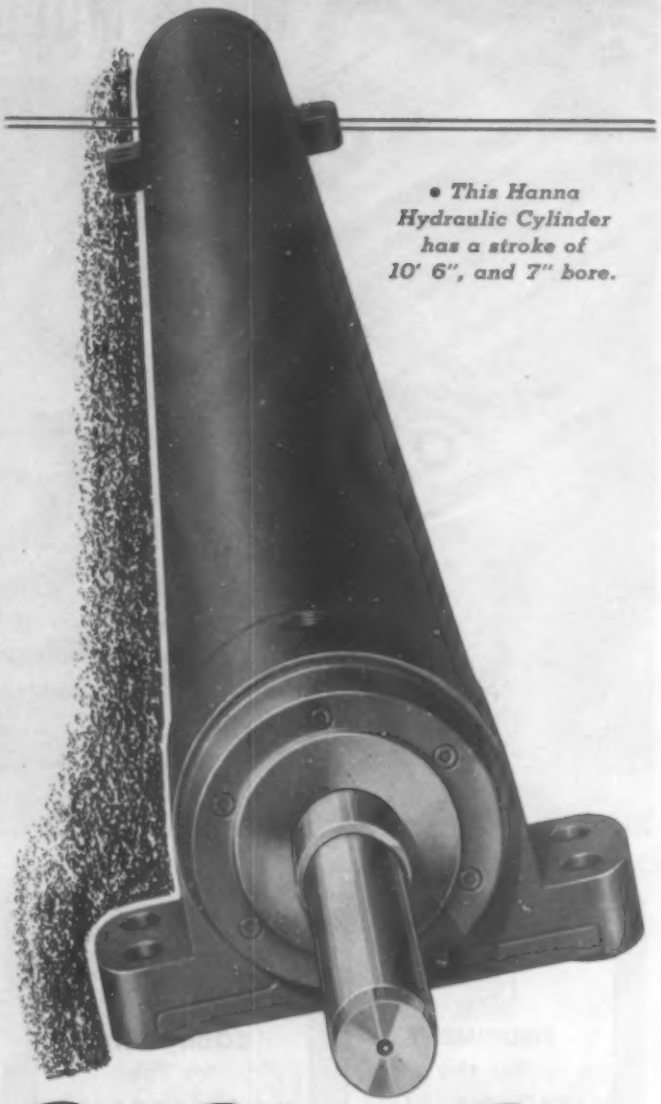

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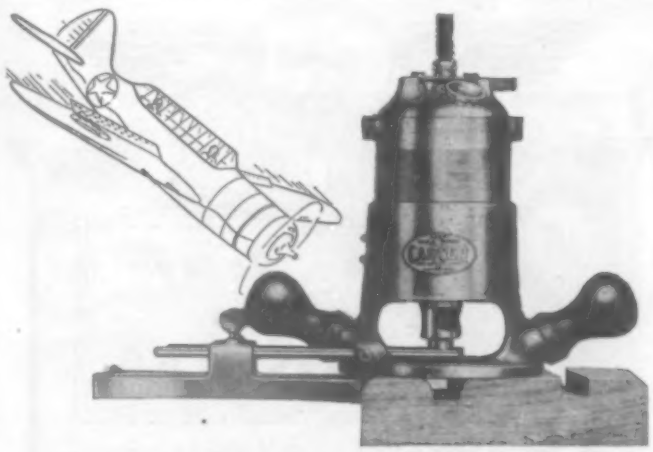

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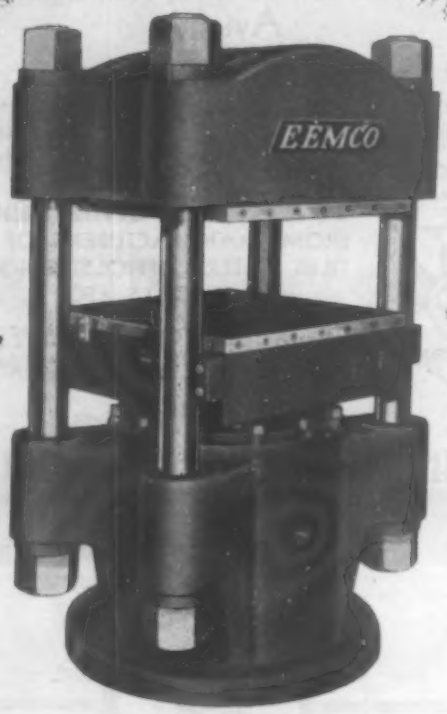

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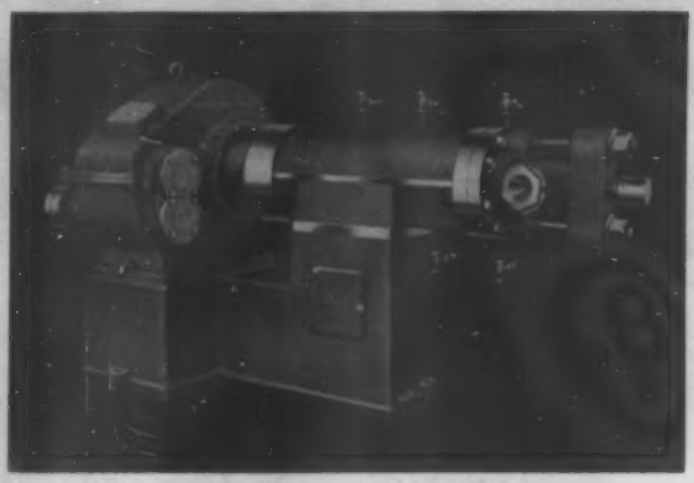

NO two plastic extrusion applications are alike—that is why it is important to put your extrusion problem in experienced hands. Practically every large, well known, and many small, plastic fabricators have made use of our "know-how." Our experience began with rubber and has grown with hundreds of installations to the profit of plastic product manufacturers. Plan today for the big future in plastics.

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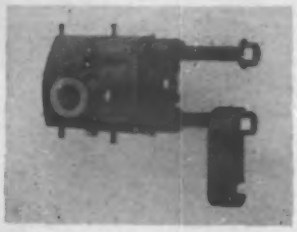
Continuous Strainers, Mixing Mills, Extruders for Rubber and Plastics, Tilting Head Presses, Hydraulic Presses, Washers, Crackers, Sheeters, Refiners, Vulcanizers, DeVulcanizers and special equipment for rubber and plastics.

CHANGE DIES IN A HURRY



A glance at the view at the left shows how the die head is swung open for removal or cleaning. An N. E. Extruder will handle any cross section of plastic material.

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PRECISION is vital to victory!

Your products are no better than the tools which guide their manufacture. Tools, molds, and gages engineered to ELECTRIX standards will enable you to operate more efficiently, with fewer rejects.

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YESTERDAY

Almost as long as the history of civilized man himself is the span of rivet's service in man's wars. The armor of Richard the Lion Hearted, of Crusader fame, of Joan of Arc, of Roman legionnaires, of Greek heroes owed its existence to the use of the lowly rivet.

TODAY

Perhaps you are using rivets now in one of your fastening operations. Getting the job done faster, cutting labor costs, turning out a better product are problems you have to face daily. Oft times, where riveting operations are involved, customers pass their problems on to us, and from the accumulated experience thus gained we are often able to supply the missing answer. Whether you now use MILFORD RIVETS or those made by some other manufacturer in your product is immaterial. If we can help to win the war faster by speeding a defense job we want to contribute any skill as rivet specialists we may possess. Will you let us cooperate, accepting our offer in the spirit of "the American way"?

TOMORROW

As the war draws nearer to its close more and more manufacturers are dusting off the blueprints of that "postwar product," looking to the day when the signal is given to resume making civilian goods. Some of these products will require fastening. Don't overlook the advantages of rivets when your fabricating plans are under discussion.

PERMANENCY—LOW COST
SPEED OF APPLICATION
AVAILABILITY OF SUPPLY

—these are a few of the factors which may serve to give you the edge on competing products. We would like to think ahead with you now instead of waiting for the zero hour. Present mass production for war needs still leaves our rivet engineers with time to interest themselves in your fastening requirements.

★ ★ ★ ★ ★

The MILFORD RIVET & MACHINE CO.

Post Road, Milford, Connecticut

. . . we must win another and *Greater Award*

While we have won the Treasury Department "Minute Man Flag" for 100% participation in War Bond Drives—The Army-Navy "E" burgee for excellency in war production and later the coveted star for continued performance—there is still one award for which we all strive and work and that is Victory.

When peacetime pursuits are again resumed Franklin will be ready to supply you with plastic molded parts for your production. Of course we are up to our ears in war work now, but somehow we will find time to talk to you if you will write and ask us to call.

ARMY E NAVY

Franklin

FRANKLIN PLASTICS DIVISION
Robinson Industries Inc., -- FRANKLIN, PA.

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MMM CO

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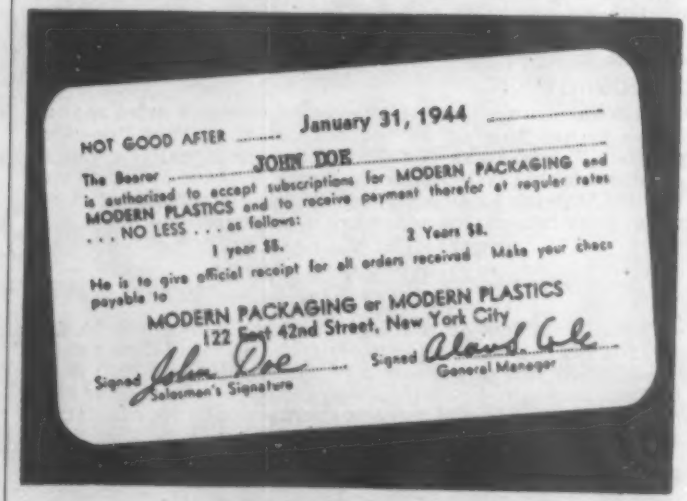
NOT GOOD AFTER ..... January 31, 1944 .....

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Signed John Doe ..... Signed Alan S. Cole
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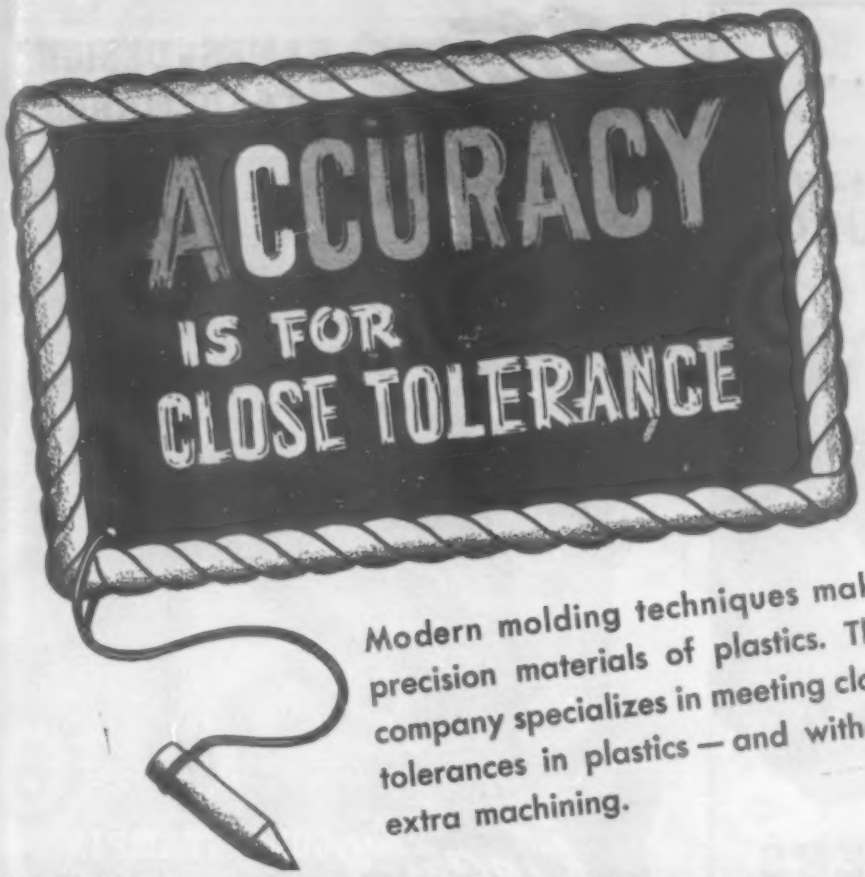

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Consult our engineers for war and post-war products

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★ If your post-war products will require plastic parts in their construction, we suggest that you establish a source of production today to avoid the expected rush for plastics tomorrow.

Every day more manufacturers can see what their plastic requirements are to be and, consequently, they plan constructively for the post-war period and the great demand for plastic production that will come with it. We urge you, therefore, to consult with our engineering department now. Get cost-free advice from seasoned plastic experts. Your action now will help get your products on the market quickly when peace comes.

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TO CUT COSTS

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Exterior of Infra-Red Conveyor Belt Tunnel for removing moisture from plastic material prior to molding.

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High Pressure Regulating Valve

Most plastics plants use high pressure fluids and those fluids must be regulated. This remarkable valve takes care of air, water, or oil, up to 6,000 lb. per sq. in. *without shock.*

Is it Dependable?

Indeed it is. Every part is up-to-date in every respect. Forged Steel Body. Internal metal parts entirely of stainless steel. A formed packing of special material superior to leather is used which is immune to all fluids commonly used in hydraulic machinery. The pressure on the seat is balanced by a piston with the result that variations in high initial pressure have little effect on the reduced pressure.

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Representatives in Principal Cities

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Check this list and mail to us with your name, firm name and address.

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It is called a "dry wave"—plastic curlers, as illustrated, to curl the hair around. The process prevents the scalp from being injured by liquid solution.

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FOR SALE: 1—Watson Stillman Hydro-Accumulator, 5½" ram; 2—Farrel Birmingham Hydraulic Presses, 24 x 24, 12" ram; 1—W. S. 13" x 18" Hydraulic Press, 10" ram; 1—14" x 24" Press, 9" ram; 4—24" x 55" steel cored Heating Platens; 4—W. & P. Mixers; 1—Elms Hydraulic Pump, 6.5 GPM at 7500# pressure PSI; 4—Semi-Automatic 100-ton Hydraulic Presses, platen area 20" x 36"; Adamson 6" Tuber; Dry Powder Mixers; Pulverizers, Grinders, etc. Send for complete list. Reply Box 447, Modern Plastics.

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HIGH GRADE SALESMAN with New York City connection with manufacturer of Top Grade Plastic Machinery. College education—Diploma in Theory—Properties Methods—Technique of Plastics. Working field knowledge of Industrial Analytical Chemistry. Practical molding knowledge. Excellent social position. Reply Box 903, Modern Plastics.

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Design background in small special machinery for development department of progressive manufacturer of synthetic materials. Excellent peacetime future. Give complete details and salary expected. Location Northern New Jersey. Reply Box 907, Modern Plastics.

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- 3 Hydraulic Presses 17" Ram, 6' 6" stroke, with pumps
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Index to Advertisements

Accurate Molding Co. 203
Allied Products Corp. 12
American Cyanamid Co. 120–121
American Insulator Corp. 194
American Plastics Corp. 190
American Screw Co. 45, 72
Amos Molded Products 160
Atlas Valve Co. 205
Auburn Button Works, Inc. 15

Bakelite Corp. Inside Back Cover
Ball & Jewell 206
Bamberger, A. 177
Barco Manufacturing Co. 30
Behr-Manning 14
Birdsboro Steel Foundry & Machine Co. 68
Boonton Molding Co. 148
Bridgeport Moulded Pdts., Inc. 66
Brilhart, Arnold, Ltd. 41
Bristol Co., The 72
Broder, Harry 206
Buttondex Corp. 207

Cambridge Instrument Co., Inc. 206
Carver, Fred S. 181
Catalin Corp. 3
Celanese Celluloid Corp. 9
Celluplastic Corp. 144
Central Process Corp. 79
Central Screw Co. 72
Chandler Products Corp. 72
Chanin Bldg. 208
Chicago Die Mold Mfg. Co. 163
Chicago Molded Products Corp. 175
Claremont Waste Mfg. Co. 122
Classified. 210–211
Coleman & Co. 22
Columbia Protektosite Co., Inc. 157
Consolidated Molded Products Corp. 53
Continental-Diamond Fibre Co. 20
Continental Screw Co. 72, 181
Corbin Screw Corp., The 72
Cordo Chemical Corp. 151
Cruver Mfg. Co. 145
Curran & Barry 207

Davis Plastics Co., Jos. 173
Delta Mfg. Co. 58
Detroit Macoid Corp. 71
Detroit Wax Paper Co. 204
DeWitt Hotels 204
Dillon-Beck Mfg. Co. 189
Disston, Henry, & Sons, Inc. 179
DoAll Co., The 40
Dow Chemical Co., The 171
du Pont de Nemours, E. I., & Co., Inc., Plastics Dept. 7
Dures Plastics & Chemicals, Inc. Inside Front Cover
Durite Plastics 147

Electrix Corp. 200
Elmes Engineering Works of American Steel Foundries 19
Erie Engine & Mfg. Co. 198
Exact Weight Scale Co. 185

Farrel-Birmingham Co., Inc. 65
Federal Telephone & Radio Corp. 56
Fortney Mfg. Co. 195
Franklin Plastics Division 201

General Electric Co. Back Cover
General Industries Co. 33
General Screw Mfg. Co. 72
Gering Products, Inc. 187
Girdler Corp., The 135

Hanna Engineering Works 194
Harper Co., H. M., The 72
Hercules Powder Co., Inc. 21
Hodgman Rubber Co. 193
Hydraulic Press Mfg. Co., The 137

Ideal Plastics Corp. 183
Industrial Hard Chromium Co. 42
Industrial Synthetics Corp. 155
Insulation Mfg. Co. 192
International Molded Plastics, Inc. 187
International Screw Co. 72

Jones Co., C. Walker 197

Kearney & Trecker Products Corp. 51
Keyes Fibre Co. 61
Kingsley Gold Stamping Machine Co. 204
Kuhn & Jacob Molding & Tool Co. 195
Kurz-Kasch, Inc. 46
Kux Machine Company 54

Lamicoid Fabricators Inc. 185
Lamson & Sessions Co., The 72
Lane, J. H. & Co., Inc. 190
Lea Mfg. Co., The 59
Leominster Tool Co., Inc. 183
Lester-Phoenix, Inc. 31
Lexington Ave. & 42nd Street Corp. 208
Lincoln Engineering Co. 36
Lucidol Corp. 199

Machinery Sales Co. 209
Mack Molding Co. 193
MacRae's Blue Book 200
Makalot Corp. 142
Maple Leaf Aircraft Corp. Ltd. 209
McAleer Mfg. Co. 70
Manufacturers Chemical Corp. 192
Mercer-Robinson Co., Inc. 193
Metal Specialty Company, The 44
Metaplast Corp. 18
Meyercord Co., The 38
Michigan Molded Plastics, Inc. 196
Midland Die & Engraving Co. 62
Midwest Molding & Mfg. Co. 202
Milford Rivet & Machine Co. 72, 201
Mills, Elmer E., Corp. 63
Minnesota Plastics Corp. 205
Miracle Adhesives Corp. 196
Molded Products Co. 48
Monroe Auto Equipment Co., Plastic Div. 23
Monsanto Chemical Co. 13, 159
Monnee Paper Mills Co. 67
Muehlstein, H. & Co., Inc. 191
Munising Paper Co. 25

National-Erie Corp. 200
National Plastic Products Co. 197
National Rubber Machinery Co. 5
National Screw & Mfg. Co. 72, 80
National Vulcanized Fibre Co. 149
New England Screw Co. 72
New York Air Brake Co. 26
Niacet Chemicals Corp. 191
Nicholson File Co. 60
Nixon Nitration Works Inc. 77
North American Electric Lamp Co. 205
Northern Industrial Chemical Co. 203
Northwest Plastics, Inc. 199
Norton Laboratories, Inc. 27

Parker, Charles, Co., The 72
Parker-Kalon Corp. 72, 146
Pawtucket Screw Co. 72
Peerless Roll Leaf Co. 179
Pheoll Manufacturing Co. 72
Phillips Screw Manufacturers 72
Plaskon Division. 114, 115
Plastic Industries Technical Institute. 74
Plastic Manufacturers, Inc. 28
Plastimold, Inc. 191
Porter-Cable Machine Co. 34
Pro-phy-lac-tic Brush Co., Prolon Plastics Div. 10
Pyro Plastics Co., The 37

Racine Tool & Machine Co. 29
Radio Corp. of America. 16–17
Rayon Processing Co. of R. I., Inc. 78
Reading Screw Co. 72
Recto Molded Products, Inc. 197
Reed-Prentice Corp. 8
Reichard-Coulston, Inc. 207
Reichhold Chemicals, Inc. 167
Reynolds Molded Plastics 64
Richardson Co., The 6
Riegel Paper Corp. 30
Rodgers Hydraulic, Inc. 57
Rogan Brothers 204
Rohm & Haas Co. 49
Royle, John & Sons 76
Russell Burdsall & Ward Bolt & Nut Co. 72

St. Louis Plastic Moulding Co. 165
Sav-way Industries 133
Schauer Machine Co. 196
Scoville Machine Co. 72
Shakeproof, Inc. 72
Shaw Insulator Co. 75
Sinko Tool & Mfg Co. 143
Society of the Plastics Industry. 150
South Bend Lathe Works 32
Southington Hardware Mfg. Co., The. 72
Standard Tool Co. 209
Stanley Works, R. L., Carter Division. 195
Sterling Plastics Co. 55
Stokes Machine Co., F. J. 153
Stokes Rubber Co., Jos. 177
Stricker-Brunhuber Co. 190

Taber Instrument Corp. 199
Taylor Instrument Companies 52
Tech-Art Plastics Co. 139
Tennessee Eastman Corp. 119
Thropp, Wm. R. & Sons Co. 190
Timken Roller Bearing Co., The. 50, 69
Tinnerman Products, Inc. 141
Trav-ler Karenola Radio & Television Corp. 207

United States Rubber Co. 11
United States Testing Co., Inc. 161
Universal Plastics Corp. 198
Union Carbide & Carbon Corp. Inside Back Cover

Varcum Chemical Corp. 24
Victory Mfg. Co. 189
Virginia-Lincoln Corp. 73

Waterbury Button Co., The. 202
Watertown Mfg. Co. 43
Watson-Stillman Co. 47
White, S. S., Dental Mfg. Co. 209
Whitney Screw Corp. 72
Worcester Moulded Plastics Co. 35

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